117
January
1985

elektor electronics

$3.50
R.R.P.
(incl. VAT)
$ 3.30

μP-controlled frequency meter

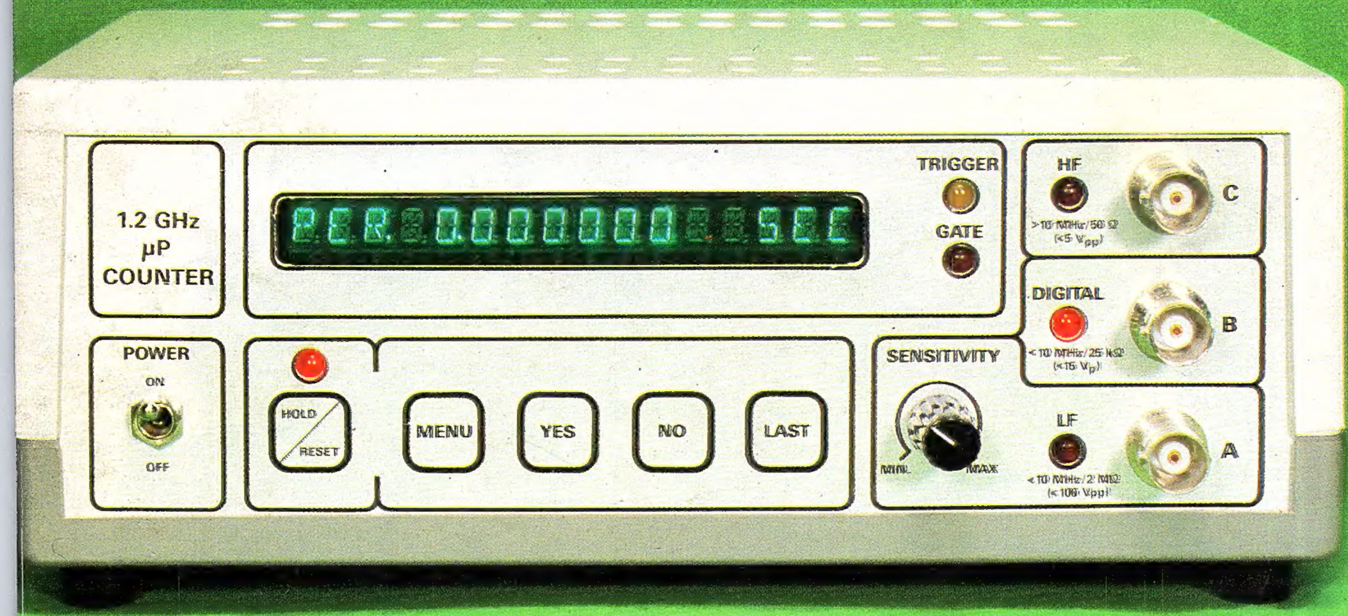
fourth in our series of measuring instruments

portable guitar amplifier

two articles for guitar lovers

cassette interface for VIC20/64

overcomes one of Commodore's shortcomings



TTLs

74 SERIES

7400	0.30
7401	0.30
7402	0.30
7403	0.30
7404	0.36
7405	0.30
7406	0.40
7407	0.40
7408	0.30
7409	0.30
7410	0.30
7411	0.30
7412	0.30
7413	0.50
7414	0.70
7416	0.36
7417	0.40
7420	0.30
7421	0.60
7422	0.36
7423	0.36
7425	0.40
7426	0.40
7427	0.32
7428	0.43
7430	0.30
7432	0.36
7433	0.30
7437	0.30
7438	0.40
7439	0.40
7440	0.40
7441	0.90
7442A	0.70
7443A	1.00
7444	1.10
7445	1.00
7446A	1.00
7447A	1.00
7448	1.00
7450	0.36
7451	0.35
7453	0.38
7454	0.38
7460	0.55
7470	0.50
7472	0.45
7473	0.45
7474	0.50
7475	0.60
7476	0.45
7480	0.65
7481	1.80
7483A	1.05
7484A	1.25
7485	1.10
7486	0.42
7489	2.10
7490A	0.55
7491	0.70
7492A	0.70
7493A	0.55
7494	1.10
7495A	0.60
7496	0.80
7497	2.10
74100	1.90
74107	0.50
74109	0.75
74110	0.75
74111	0.55
74116	1.70
74118	1.10
74119	1.70
74120	1.00
74121	0.55
74122	0.70
74123	0.80
74125	0.65
74126	0.55
74128	0.55
74132	0.75
74136	0.70
74141	0.90
74142	2.50
74143	2.70
74144	2.70
74145	1.10
74147	1.70
74148	1.40
74150	1.75
74151A	0.70
74153	0.80
74154	1.40
74155	0.80
74156	0.90
74157	0.80
74159	1.75
74160	1.10
74161	0.80
74162	1.10
74163	1.10
74164	1.20
74165	1.10
74166	1.40
74167	4.00
74170	2.00
74172	4.20
74173	1.40
74174	1.10
74175	1.05
74176	1.00
74178	1.50
74179	1.50
74180	1.00
74181	3.40
74182	1.40
74184	1.80
74185A	1.80
74190	1.30
74191	1.30
74192	1.10
74193	1.15
74194	1.10
74195	0.80
74196	1.30
74197	1.10
74198	2.20
74199	2.20
74221	1.10
74251	1.00
74259	1.50
74265	0.80
74273	2.00
74276	1.40
74278	1.70
74279	0.90
74283	1.05
74285	3.20
74290	0.90
74293	0.90
74298	1.80
74351	2.00
74365A	0.80
74366A	0.80
74367A	0.80
74368A	0.70
74376	1.60
74390	1.10
74393	1.20
74490	1.10
74393	1.20
74490	1.40

74LS SERIES

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.34
74LS14	0.50
74LS15	0.24
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.50
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.80
74LS48	0.90
74LS51	0.24
74LS54	0.24
74LS55	0.24
74LS73A	0.30
74LS74A	0.35
74LS75	0.45
74LS76A	0.36
74LS78	0.42
74LS83A	0.70
74LS85	0.75
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.35
74LS93	0.54
74LS95B	0.75
74LS96	0.90
74LS107	0.40
74LS109	0.40
74LS112	0.45
74LS113	0.45
74LS114	0.45
74LS122	0.70
74LS123	0.80
74LS124/629	1.40
74LS125	0.50
74LS126	0.50
74LS132	0.65
74LS133	0.50
74LS136	0.45
74LS138	0.55
74LS139	0.55
74LS145	0.95
74LS147	1.75
74LS148	1.40
74LS151	0.65
74LS152	2.00
74LS153	0.65
74LS154	1.60
74LS155	0.65
74LS156	0.65
74LS157	0.50
74LS158	0.65
74LS160A	0.75
74LS161A	0.75
74LS162A	0.75
74LS163A	0.75
74LS164	0.75
74LS165A	1.30
74LS166A	1.50
74LS168	1.30
74LS169	1.00
74LS170	1.40
74LS173A	1.00
74LS174	0.75
74LS175	0.75
74LS181	2.00
74LS183	1.90
74LS190	0.75
74LS191	0.75
74LS192	0.80
74LS193	0.90
74LS194A	0.75
74LS195A	0.75
74LS196	0.80
74LS197	0.80
74LS221	1.00
74LS240	0.90
74LS241	0.90
74LS242	0.90
74LS243	0.90
74LS244	0.80
74LS245	1.00
74LS247	1.10
74LS248	1.10
74LS249	1.10
74LS251	0.75
74LS253	0.75
74LS256	0.90
74LS257A	0.70
74LS258A	0.70
74LS259	1.20
74LS260	0.75
74LS261	1.20
74LS266	0.60
74LS273	1.25
74LS279	0.70
74LS280	1.90
74LS283	0.80
74LS290	0.80
74LS292	9.00
74LS293	0.80
74LS295	1.40
74LS297	9.00
74LS298	1.00
74LS299	2.20
74LS231	3.70
74LS324/624	3.50
74LS348	2.00
74LS352	1.20
74LS353	1.20
74LS356	2.10
74LS363	1.80
74LS364	1.80
74LS365	0.50
74LS366	0.50
74LS367	0.52
74LS368	0.50
74LS373	0.90
74LS374	0.90
74LS375	0.75
74LS377	1.10
74LS378	0.95
74LS379	1.40
74LS381	4.50
74LS390	0.60
74LS393	1.10
74LS395A	1.00
74LS399	1.40
74LS445	1.80
74LS465	1.20
74LS467	1.80
74LS540	1.00
74LS541	1.00
74LS608	7.00
74LS610	19.00
74LS612	19.00
74LS626	2.25
74LS628	2.25
74LS629	1.40
74LS640	3.00
74LS640-1	3.00
74LS641	2.00
74LS642	2.50
74LS642-1	3.00
74LS643	2.50
74LS643-1	3.00
74LS644	3.50
74LS645	2.00
74LS645-1	4.00
74LS668	0.90
74LS669	0.90
74LS670	1.80
74LS682	3.20
74LS684	6.50
74LS687	5.50
74C922	6.50
74C923	6.50
74C925	6.50
74C926	6.50
74C928	6.50

4000 SERIES

4000	0.20
4001	0.24
4002	0.25
4006	0.70
4007	0.25
4008	0.60
4009	0.45
4010	0.60
4011	0.24
4012	0.25
4013	0.36
4014	0.60
4015	0.70
4016	0.36
4017	0.55
4018	0.60
4019	0.60
4020	0.80
4021	0.60
4022	0.70
4023	0.30
4024	0.48
4025	0.24
4026	0.90
4027	0.40
4028	0.60
4029	0.75
4030	0.35
4031	1.25
4032	1.00
4033	1.25
4034	2.50
4035	0.70
4036	2.50
4037	1.10
4038	1.00
4039	2.50
4040	0.60
4041	0.55
4042	0.50
4043	0.60
4044	0.60
4045	1.00
4046	0.60
4047	0.60
4048	0.55
4049	0.36
4050	0.35
4051	0.65
4052	0.60
4053	0.60
4054	0.80
4055	0.80
4056	0.85
4059	4.00
4060	0.70
4063	0.85
4066	0.40
4067	2.30
4068	0.25
4067	0.24
4068	0.25
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.65
4077	0.25
4078	0.25
4081	0.24
4082	0.25
4085	0.60
4086	0.75
4089	1.20
4093	0.35
4094	0.90
4095	0.90
4096	0.90
4097	2.70
4098	0.75
4099	0.90
4501	0.36
4502	0.55
4503	0.36
4504	0.95
4505	3.60
4506	0.90
4507/4030	0.35
4508	1.20
4510	0.55
4511	0.55
4512	0.55
4513	1.50
4514	1.10
4515	1.10
4516	0.55
4517	2.20
4518	0.48
4519	0.32
4520	0.60
4521	1.15
4522	0.80
4526	0.70
4527	0.80
4528	0.65
4529	1.00
4531	0.75
4532	0.65
4534	3.80
4536	2.50
4538	0.75
4539	0.75
4541	0.90
4543	0.70
4551	1.00
4553	2.40
4555	0.36
4556	0.50
4557	2.40
4560	1.40
4566	1.40
4568	2.40
4569	1.70
4572	0.45
4583	0.90
4584	0.48
4585	0.60
4724	1.50
14411	7.50
14412	7.50
14416	3.00
14419	2.60
14490	4.20
14495	4.50
14500	6.50
14599	2.00
22100	3.50
22101	7.00
22102	7.00
40014	0.48
40085	1.20
40097	0.36
40098	0.40
40100	1.50
40101	1.25
40102	1.30
40103	2.00
40104	1.20
40105	1.50
40106	0.48
40107	0.55
40108	3.20
40109	0.80
40110	2.25
40114	2.25
40147	2.80
40163	1.00
40173	1.20
40174	1.00
40175	1.00
40192	1.00
40193	1.00
40194	1.00
40244	1.50
40245	1.50
40257	1.80
40373	1.80
40374	1.80
80C95	0.75
80C97	0.75
80C98	0.75

Full range of 74S & 74HC series in stock. Ask for full list.

zif sockets

24 pin	5.50
28 pin	7.00
40 pin	8.00

TTL & ECL

10116	70p
10231	350p

LINEAR I.Cs

AD7581	15.00
ADC0808	11.90
AM7910DC	25.00
AN103	2.00
AY1-5050	1.00
AY3-1270	7.50
AY3-1350	3.50
AY3-8910	4.00
AY3-8912	5.0
CA3019A	1.00
CA3028A	1.10
CA3046	0.70
CA3059	3.20
CA3060	3.50
CA3080E	0.70
CA3086	0.60p
CA3089E	2.10
CA3090AQ	3.75
CA3130E	0.90
CA3130T	1.30
CA3140E	0.45
CA3140T	1.00
CA3146	2.25
CA3160E	0.90
CA3161E	1.60
CA3162E	4.40
CA3189E	2.70
CA3240E	1.50
CA3280G	2.70
D7002	12.00
DAC0800	2.25
DAC0808	2.25
DG308	3.00
HA1366	1.90
ICL7106	6.75
ICL7611	8.95
ICL7650	4.00
ICL7660	2.50
ICL8038	3.00
ICM7216B	22.00
ICM7217	7.50
ICM7555	0.90
ICM7556	1.40
LC7120	3.00
LC7130	3.00
LC7431	3.50
LC7137	3.50
LF347	1.50
LF351	0.60
LF353	0.90
LF355	0.90
LF356N	0.95
LF357	1.00
LF13331	3.50
LM10CLH	4.50
LM301A	0.30
LM307	0.45
LM308CN	0.75
LM310	2.25
LM311	0.60
LM318	1.50
LM319	1.80
LM324	0.45
LM334Z	1.15
LM335Z	1.30
LM336	1.60
LM339	0.40
LM348	0.60
LM358P	0.50
LM377	2.10
LM380N-8	1.50
LM380N	1.20
LM381AN	1.70
LM382	2.00
LM383	3.25
LM384	2.20
LM386N-1	1.00
LM387	2.70
LM389	1.80
LM391	1.80
LM392N	1.10
LM393	0.85
LM394CH	3.75
LM709	0.35
LM710	0.48
LM711	1.00
LM723	0.60
LM725CN	3.00
LM733	0.65
LM741	0.16
LM747	0.70
LM748	0.30
LM1011	4.80
LM1014	1.50
LM1801	3.00
LM1830	2.50
LM1871	3.00
LM1872	3.00
LM1886	6.00
LM1889	4.50
LM2917	3.00
LM3302	0.75
LM3900	0.80
LM3909	1.00
LM3911	1.80
LM3914	3.50
LM3915	3.40
LM3916	3.40
LM13600	1.50
M51513L	2.30
M51516L	4.50
MB3712	2.00
MB3730	4.00
MC1310	1.50
MC1413	0.75
MC1445	2.50
MC1458	0.45
MC1495L	2.50
MC1496	0.70
MC3340	2.00
MC3401	0.50
MC3403	0.65
MF10CN	3.40
MK50240	9.00
MK50398	7.90
ML920	5.00
ML922	4.00
MM66221A	3.00
NE531	1.20
NE555	0.22
NE556	0.60
NE564	4.00
NE565	1.20
NE566	1.50
NE567	1.25
NE570	4.00
NE571	3.00
NE592	0.90
NE5532P	1.50
NE5533P	1.60
NE5534P	1.20
NE5534AP	1.50
OP-07EP	5.00
PLL02A	5.00
RC4136	0.55
RC4151	2.00
RC4195	1.50
RC4558	0.55
S566B	2.20
S50240	9.00
SAA1900	16.00
SFF96364	8.00
SL490	3.00
SN76013N	3.00
SN76023N	3.00
SN76033N	3.00
SN76115N	2.15
SN76489	4.00
SN76495	4.00
SN76660	1.20
SPO256AL2	7.00
SP8515	7.50
TA7120	1.20
TA130	1.40
TA7204	1.50
TA7205	0.90
TA7222	1.50
TA7310	1.50
TBA641BX1	4.00
TBA231	1.20
TBA800	0.80
TBA810	0.90
TBA820	0.90
TBA820M	0.75
TBA920	2.00
TBA950	2.25
TC9109	5.00
TCA210	3.50
TCA220	3.50
TCA940	1.75
TDA1004A	5.00
TDA1010	2.25
TDA1022	4.50
TDA1024	1.10
TDA1170S	3.00
TDA2002	3.25
TDA2003	1.90
TDA2004	2.40
TDA2006	3.20
TDA2020	3.20
TDA2030	1.80
TDA541	4.00
TDA2591	4.00
TDA2593	5.00
TDA2653	7.00
TDA3560	9.90
TDA3810	7.50
TDA7000	3.50
TEA1002	7.00
TL061CP	0.40
TL062	0.60
TL064	0.90
TL071	0.40
TL072	0.70
TL074	1.10
TL081	0.35
TL082	0.55
TL083	0.75
TL084	1.00
TL094	2.00
TL170	0.50
TL430C	1.20
UAA1003-9	9.35
UA759	3.20
UA2240	1.20
UAA170	1.70
UCN4801A	5.50
ULN2001A	0.75
ULN2002A	0.75
ULN2003A	0.75
ULN2004A	0.75
LN2068	2.90
ULN2802	1.90
ULN2803	1.80
ULN2804	1.90
UPC575	2.75
UPC592H	2.00
UPC1156H	3.00
UPC1185H	5.00
XR210	4.00
XR2206	4.00
XR2207	3.75
XR2211	5.75
XR2216	6.75
XR2240	1.20
ZN404	1.20
ZN414	0.80
ZN419P	1.75
ZN423E	1.30
ZN424E	1.30
ZN425E8	3.50
ZN426E8	3.00
ZN427E8	6.00
ZN428E8	4.50
ZN429E8	2.25
ZN447E	9.00
ZN450E	7.50
ZN459CP	3.00
ZN1034E	2.00
ZN1040	6.60
ZNA134J	23.00
ZNA234E	9.50

VOLTAGE REGULATORS

1A FIXED VOLTAGE PLASTIC TO220

+VE			–VE	
5 V	7805	0.45	7905	0.50
6 V	7806	0.50	7906	0.50
8 V	7808	0.50	7908	0.50
12 V	7812	0.45	7912	0.50
15 V	7815	0.50	7915	0.50
18 V	7818	0.50	7918	0.50
24 V	7824	0.50	7924	0.50

1A FIXED VOLTAGE PLASTIC TO92

5 V	78L05	0.30	15 V	78L15	0.30
6 V	78L06	0.30	5 V	79L05	0.45
8 V	78L08	0.30	12 V	79L12	0.50
12 V	78L12	0.30	15 V	17L15	0.50

OTHER REGULATORS

LM309K	1.40
LM323K	3.50
78HO5KC	5.40
78H12	6.40
78PO5	9.00

SWITCHING REGULATORS

ICL7660	2.50
SG3524	3.00
TL494	3.00
TL497	3.00
78S40	2.50
RC4195	1.50

VARIABLE REGULATORS

LM305AH	2.50	LM723N	0.50
LM317T	1.50	78HGKC	5.75
LM317K	2.40	78GUIC	2.25
LM337T	2.25	79HGKC	6.75
LM350T	4.00	79GUIC	2.50
LM396K	15.00	79MGT2C	1.40

OPTO-ISOLATORS

ILD74	1.30	TIL112	0.70
ILQ74	2.20	TIL113	0.70
MCT26	1.00	TIL116	0.70
MCS2400	1.90	6N137	3.60
MOC3020	1.50	6N139	1.75
TIL111	0.70		

DISPLAYS

DL704 RED	1.40	MAN4640	2.00
DL707 RED	1.40	MAN6610	2.00
FND357	1.00	NSB5881	5.70
FND500/TIL730	1.00	TIL311	6.50
FND507/TIL729	1.00	TIL729	1.00
MAN74/DL704	1.00	TIL730	1.00
MAN71/DL707	1.00	MAN8910	2.50
MAN3640	1.75	MAN8940	2.50

DISPLAY DRIVERS

9368	4.50	ULN2004	0.90
9370	4.50	ULN2068	2.90
LM3914	3.50	ULN2802	1.90
LM3915	3.50	ULN2803	1.80
LM3916	3.50	ULN2804	1.90
UDN6118	3.20	75491	0.70
UDN6184	3.20	75492	0.70
ULN2003	0.90		

OTHERS

2N5777	0.50	ORP12	1.20
BPX25	1.80	ORP60	1.20
BPW21	2.80	ORP61	1.20
OCP71	1.80	SFH205	1.00

ATTENTION
ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

SCRS

1A 50V	70p
5A 400V	50p
8A 600V	140p
16A100V	200p
C106D	45p
MCR101	36p
T1C44	36p
2N3525	130p
2N4444	140p
2N5060/4	40p

ZENERS

2 7V-33V

400MW	9p
1W	15p

TRIACS

Plastic

3A 400V	60p
6A 400V	70p
6A 500V	90p
8A 400V	75p
8A 500V	95p
12A500V	105p
16A500V	130p
T 2800D	130p
T1206D	50p
T1226D	70p

DISCRETE DISPLAYS LEDS

125''

RED TIL209	0.12
GREEN TIL211	0.16
YELLOW TIL212	0.20
Rect LEDs (R/G/Y)	0.30
CXQ (Bi Colour	1.00

10 LED Bargraph:

Red	2.25
Green	2.25

0.2''

TIL220	0.15
TIL222	0.18
TIL226	0.22
TIL32	0.55
TIL78	0.55
TIL31B	1.20
TIL81	1.20
TIL100	0.75

CPU's

1802CE	6.50
2650A	12.00
6502	3.50
65C02	15.00
6502A	5.50
6502B	8.00
6800	2.50
6802	3.00
6809	6.50
6809E	12.00
Z80A	3.25
Z80B	8.00
68B09	12.00
68B09E	16.00
68000-L8	36.00
8035	3.60
8039	4.20
8080A	4.20
8085A	6.50
8086	22.00
8088	17.50
8748	P.O.A.
TMS1601	12.00
TMS9980	12.00
TMS9995	12.00
WD55	14.50
Z80	3.25
Z80A	3.75
Z80B	8.00

SUPPORT DEVICES

2651	12.00
3242	8.00
3245	4.50
6520	3.00
6522	3.50
6552	2.50
6522A	5.50
6532	5.20
6551A	5.50
6821	1.50
68B21	2.20
6829	12.50
6840	3.75
68B40	6.00
6850	1.60
68B50	2.50
6852	2.50
6854	6.50
68B54	8.00
6875	5.00
8154	8.50
8155	4.00
8156	4.00
8205	2.25
8212	2.20
8216	1.60
8224	3.00
8226	3.00
8228	4.20
8243	2.90
8250	9.50
8251A	3.50
8253C-5	3.70
8255AC-5	4.00
8256	16.00
8257C-5	4.00
8259C-5	4.00
8275	29.00
8279	5.00
8284	7.50
8282	4.50
8283	4.00
8287	4.25
8288D	11.00
8755A-0/1/2/9	24.00
TMS9903	25.00
TMS9911	18.00
TMS9914	14.00
Z80P10	2.60
Z80AP10	3.25
Z80CTC	2.60
Z80ACTC	3.25
Z80DART	6.50
Z80ADART	8.00
TMS4500	14.00
TMS9901	5.00
TMS9902	5.00
Z80ADMA	9.00
Z80ASIO	9.00

RAMS

2016-150	4.00
2101	4.00
27102	2.50
2107B	5.00
2111A-35	4.00
2114-2	3.50
2114-3	2.50
2114-4	2.00
2147	3.20
4027-3	3.00
4116-15	2.00
4116-20	1.50
4118-3	5.00
4164-15 (TI)	5.00
4164-15	4.50
4164-20	4.20
4416-15	5.00
4532-20	2.50
4816AP-3	2.00
5101/5501	3.70
5516	6.50
6116P-3	4.50
6116LP-3	9.50
6264-15	28.00
6514-45	2.50
6810	1.60
74S189	2.25
74S201	3.50
74S289	2.25
93415	6.00
93L422	9.50
93425	6.00

ROMS/PROMS

28L22	4.75
24S10	2.50
18S030	2.00
18SA030	2.00
74S188	1.80
74S287	2.25
74S288	1.80
74S387	2.25
74S473	4.75
74S474	4.00
74S570	6.50
74S571	3.00
74S573	5.50
82S23	1.50
82S123	1.50
82S129	1.75

EPROMS

2516 + 5V	3.50
2516-35	5.50
2532	4.50
2532-30	5.50
2564	6.50
2708	3.00
2716 + 5V	3.50
2716-35	5.50
2732	4.50
2732A-2	7.00
2732A-30	6.00
2732A-35	5.50
2764-25	5.00
27256-30	54.00
27256-25	60.00
27C64-25	14.00
27128-25	18.00
27128-30	16.00
TMS2716	5.00

CRT CONTROLLER

CRT5027	18.00
CRT6545	9.00
EF9364	8.00
EF9365	30.00
EF9366	30.00
EF9367	36.00
MC6845	6.50
MC6845SP	7.50
MC6847	6.50
SFF96364	8.00
TMS9918	30.00
TMS9927	14.00
TMS9928	20.00
TMS9929	16.00

CRYSTALS

32.768 kHz	1.00
1.00 MHz	2.70
1.8432 MHz	2.25
2.00 MHz	2.25
2.45760 MHz (S)	2.00
2.5 MHz	2.50
2.662 MHz	2.50
3.12 MHz	1.75
3.276 MHz	1.50
3.5795 MHz	1.00
4.00 MHz	1.40
4.194 MHz	1.50
4.43 MHz	1.00
4.608 MHz	2.50
4.9152 MHz	2.00
5.000 MHz	1.50
6.00 MHz	1.40
6.144 MHz	1.40
7.00 MHz	1.50
7.168 MHz	1.75
8.00 MHz	1.50
8.867 MHz	1.75
10.00 MHz	1.75
10.50 MHz	2.50
10.70 MHz	1.50
11.00 MHz	3.00
12.00 MHz	1.50
14.00 MHz	1.75
14.318 MHz	1.60
14.756MHz	2.50
15.00 MHz	2.00
16.00 MHz	2.00
17.734 MHz	2.00
18.00 MHz	1.70
18.00 MHz	1.70
18.432 MHz	1.50
19.969 MHz	1.50
20.000 MHz	1.75
24.000 MHz	1.50
48.00 MHz	1.75
116 MHz	2.50
PXO1000	12.00

DISC CONTROLLERS

6843	8.00
8272	26.00
FD1771	20.00
FD1791	20.00
FD1793	20.00
FD1795	28.00
FD1797	22.00
WD2793	36.00
WD2797	32.00
WD1691	15.00
WD2143	8.00

CHARACTER GENERATORS

RO-3-2513	UC7.50
RO-3-2513	LC7.00
DM86S64	12.00
MCM66760	7.50

BAUDRATE GENERATOR

MC14411	7.50
COM8116	6.50
4702B	7.50

KEYBOARD ENCODER

AY-5-2376	11.50
AY5-3600	7.50
74C922	6.50
74C923	6.50

UHF MODULATORS

6 MHz	3.75
8 MHz	4.50
SOUND & VISION 12 MHz	12.00

INTERFACES ICS

AD561J	20.00
AM25S10	3.50
AM25LS2521	3.50
AM25LS2538	3.50
AM26LS31	1.20
AM26LS32	1.20
AM7910DC	25.00
DAC80-CB1-V	28.00
DM8131	6.00
DP8304	3.50
DS3691	5.00
DS8830	1.40
DS8831	1.50
DS8832	1.50
DS8833	2.25
DS8836	1.50
DS8838	2.25
LF13201	4.50
MC1488	0.60
MC1489	0.60
MC3446	2.50
MC3459	4.50
MC3470	4.75
MC3480	8.50
MC3486	2.25
MC3487	2.25
MC4024	3.25
MC4044	3.25
MC14411	9.00
MC14412	7.50
75107	0.90
75108	0.90
75109	1.20
75110	0.90
75112	1.60
75113	1.20
75114	1.40
75115	1.40
75121	1.40
75122	1.40
75150P	1.20
75154	1.20
75159	2.20
75160	5.00
75161	3.50
75162	4.00
75172	3.00
75182	0.90
75188	0.60
75189	0.60
75365	1.50
75451	0.50
75452	0.50
75453	0.70
75454	0.70
75480	1.50
75491	0.65
75492	0.65
8T26	1.20
8T28	1.20
8T95	1.20
8T96	1.20
8T97	1.20
8T98	1.20
81LS95	1.40
81LS96	2.20
81LS97	1.40
81LS98	2.20
81LS120	5.00
9602	3.00
9636A	1.60
9637AP	1.60
9638	1.60

REAL TIME CLOCK

MC6818P	4.50
MM58174AN	8.50
MSM5832RS	3.50

TELETEXT DECODER

SAA5020	6.00
SAA5030	7.00
SAA5041	16.00
SAA5050	9.00

UARTS

AY-3-1015P	3.0
AY-5-1013P	3.0
COM8017	3.0
IM6402	3.6
TR1602	3.0

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	9p	18 pin	16p	24 pin	24p
14 pin	10p	20 pin	18p	28 pin	26p
16 pin	11p	22 pin	22p	40 pin	30p

WIRE WRAP SOCKETS BY TEXAS

8 pin	30p	18 pin	50p	24 pin	75p
14 pin	42p	20 pin	60p	28 pin	100p
16 pin	45p	22 pin	65p	40 pin	130p

Turned Pin Low Profile Sockets

8 pin	20p	16 pin	30p	20 pin	40p	28 pin	60p
14 pin	25p	18 pin	35p	24 pin	50p	40 pin	90p

TRANSISTORS

BC107/8	18p	BC557B	18p	BFY50/51	30p	TIP36C	150p	2N3055	55p
BC109B	18p	BC558B	18p	BFY52	30p	TIP41C	50p	2N3442	140p
BC109/C	20p	BC559C	24p	BFY90	90p	TIP42A	60p	2N3702/3	16p
BC141	40p	BCY71	36p	MJ2501	225p	TIP42C	65p	2N3704/5	16p
BC161	40p	BCY72	30p	MJ2955	90p	TIP47	90p	2N3773	200
BC177	30p	BD131	75p	MJ3001	225p	TIP54	160p	2N3819	40
BBC179	30p	BD132	80p	MJE2955	150p	TIP55	180p	2N3866	90
BC182/L	15p	BD135	40p	MJE3055	125p	TIP125	70p	2N3904/6	18
BC184/L	20p	BD136	40p	MPF102	40p	TIP2955	90p	2N4871	50
BC212/L	16p	BD139	40p	MPF103/4	40p	TIP3055	70p	2N5245	40
BC213/L	16p	BD241B	75p	MPF105	40p	2N2160	350p	2N5457/8	30
BC214/L	18p	BD242B	75p	MPSA12	50p	2N2219A	30p	2N5459	30
BC327	16p	BD244B	40p	TIP29C	40p	2N2222A	30p	2N5883	375
BC338	16p	BF256B	50p	TIP31B	40p	2N2484	30p	2N6027	30
BC477	36p	BF257/8	40p	TIP31C	45p	2N2646	50p	3N128	200
BBC516/7	50p	BF259	40p	TIP32C	45p	2N2905A	30p	3N140/1	200
BBC547/B	20p	BF337	36p	TIP33C	80p	2N3053	36p	40673	90
BBC548C	16p	BFR80/81	32p	TIP35C	140p	2N3054	60p		

IDC CONNECTORS

	10 way	20 way	26 way	34 way	40 way	50 way
Header Plug	90p	145p	175p	200p	220p	235p
Receptacle	85p	125p	150p	160p	190p	200p
Edge Conn.	120p	195p	240p	320p	340p	390p

EURO CONNECTORS

	Plug	Socket
DIN 41612 2 · 32-way	300p	350p
angled 2 · 32-way	350p	400p
angled 3 · 32-way	400p	—
(for 2 · 32 way specify a · b or a · c)		
DIN 41617 21-way	160p	165p
DIN 41617 31-way	170p	170p
DIN 41612		
2 x 32 way St Pin	230p	275p
2 x 32 way Ang Pin	275p	320p
3 x 32 way St Pin	260p	300p
3 x 32 way Ang Pin	375p	400p
1 DC Skt A + B	275p	
A + C	350p	

For 2 x 32 way please specify spacing (A + B, A + C)

DIODES

BY127	12p	OA200	9p	IN4003/4	5p
OA47	10p	OA202	10p	IN4006/7	7p
OA90	9p	IN914	4p	IN5401/2	12p
OA91	9p	IN4148	4p	IN5403/4	14p
OA95	9p	IN4001/2	5p	IS920	9

BRIDGES

1A50V	19p	2A400V	45p	6A100V	10
1A100V	20p	3A200V	60p	6A400V	12
1A600V	30p	4A100V	95p	8A100V	15
2A50V	30p	4A400V	100p	10A100V	180
2A100V	35p	6A50V	80p	10A400V	20

MIN. D CONNECTORS

	9 way	15 way	25 way	37 way	50 w
MALE					
solder	60p	85p	1.25p	2.40p	4.0
angled	1.20p	1.80p	2.40p	3.50p	—
FEMALE					
solder	90p	1.30p	1.95	2.90p	5.0
angled	1.60p	2.10p	2.90p	4.40p	—
hood (top/side entry)	90p	85p	90p	1.00p	—

25 way Centronix Type Conn. .... 5.50 pou

37 way Centronix Type Conn. .... 5.50 pou

IDC 25 way plug 3.85p Socket 4.50p.

TECHNOMATIC LTD

MAIL ORDERS TO: 17 BURNLEY ROAD, LONDON NW10 1ED
SHOPS AT: 17 BURNLEY ROAD, LONDON NW10
(Tel: 01 208 1177 Telex: 922800)
305 EDGWARE ROAD, LONDON W2

PLEASE ADD 50p p&p & 15% VAT

(Export: no VAT, p&p at Cost)

Orders from Government Depts. & Colleges etc. welcome.

Detailed Price List on request.
Stock items are normally by return of post.

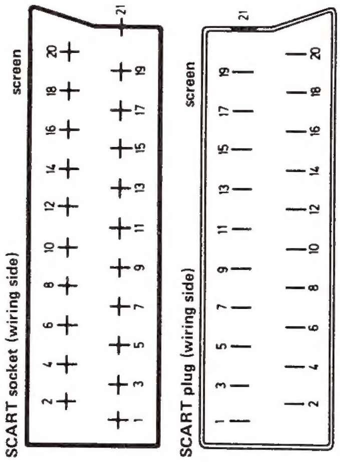
elektor index | DECEMBER | 1984

electronic candle 12-22
Looks and acts like the real thing, but is safer.
the XR2206 in the function generator 12-24
Why we have used this oldish IC in a new function generator.
shortband BASIC 12-27
Allows BASIC programs to be entered much faster than usual.
function generator 12-30
A simple, accurate sine, triangle and square wave generator.
time switch 12-36
To make a NiCad charger more user-friendly.
cumulative index 1984 12-41
musical greeting cards 12-44
How to remove the 'music' and use it for another purpose.
give your soldering tip a longer life 12-47
A protection circuit for the bit in a soldering rion.
computer-controlled slide fader 12-50
Fades pictures into each other on the screen and can also control other equipment.
slot-car controller 12-61
Power source and improved speed control in a single circuit.
microprocessor-controlled frequency meter (part 0) 12-64
A look at the features this indispensible instrument will bring.

---

lektor infocard 108 | Standard 22 | SCART connector

he SCART connector is a 21-way audio/video nk. It was especially designed for connections etween a colour TV set and various ssociated equipment such as video cassette ecorder (VCR), TV camera, prestel decoder, ome computer, games computer and so on. he great advantage of this connector is that it nables all the wires to be fed into the tele- sion set at one point instead of having to use l the various different cables and types of ugs and sockets that have been the norm.



---

lektor datacard | Transistors: BD643/644/645/646/647/648/649/650/651/652

type	characteristics	maxima
D643 D645 D647 D649 D651 PN darlington ansistors r LF plications	$I_{CBO} \le 200\ \mu A$ (U_{CBOmax}) $I_{CEO} \le 500\ \mu A$ (½U_{CEOmax}) $U_{CEsat} \le 2.0$ V ($I_C = 3$ A, $I_B = 12$ mA) $U_{BE} \le 2.5$ V $f_T = 7$ MHz ($U_{CE} = 3$ V, $I_C = 3$ A)	**BD** U_{CBO} U_{CEO} 643 45 45 V 645 60 60 V 647 80 80 V 649 100 100 V 651 140 120 V **BD** $-U_{CBO}$ $-U_{CEO}$ 644 45 45 V 646 60 60 V 648 80 80 V 650 100 100 V 652 120 120 V $\lvert U_{EBO}\rvert$ = 5 V $\lvert I_{CAV}\rvert$ = 8 A $\lvert I_{CM}\rvert$ = 12 A $\lvert I_B\rvert$ = 150 mA P_{tot} = 62.5[1] mA) T_j = 150 °C
D644 D646 D648 D650 D652 NP darlington nsistors r LF plications	$-I_{CBO} \le 200\ \mu A$ ($-U_{CBOmax}$) $-I_{CEO} \le 500\ \mu A$ ($-U_{CEOmax}$) $-U_{CEsat} \le 2.0$ V ($-I_C = 3$ A, $-I_B = 12$ mA) $-U_{BE} \le 2.5$ V $f_T = 7$ MHz ($-U_{CE} = 3$ V, $-I_C = 3$ A)	
	Data is valid under the conditions stated in brackets	[1]up to $T_{mb} = 25°C$

elektor index | Missing link | 1983

acoustic telephone modem
(February 1983, page 2-42) 10-46
car PDM amplifier
(Summer circuits 1983, page 7-36) 9-59
Crescendo (December 1982, page 12-32) 11-41
drum interface (November 1982, page 11-20) 11-41
electronic voltage regulator
(October 1983, page 10-57) 12-39
floppy disk interface for the Junior Computer
(December 1982, page 12-48) 9-59, 11-41
in-car ioniser (December 1982, page 12-45) . . 11-41
infocard 55 9-59
infocard 70 9-59
low cost CMOS lock
(Summer circuits 1983, page 7-75) 10-47
morse decoding with the Z80A
(May 1983, page 5-60) 10-46
morse converter (May 1983, page 5-52) 9-59
music quantisizer (October 1983, page 10-33) 11-41
personal FM (September 1983, page 9-46) . . 12-39
parallel-serial keyboard converter
(May 1983, page 5-50) 10-46
7-day timer/controller (April 1983, page 4-42) 12-39
single channel infra-red remote control
(January 1982, page 1-52) 11-41
64 K on the 16 K dynamic RAM card
(September 1983, page 9-31) 11-41
upper and lower case on the Elekterminal
(January 1983, page 1-56) 11-41

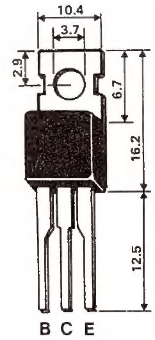
---

elektor infocard 108 | Standard 22 | SCART connector

Pin	Function	Level
1	Audio output (right-hand) or channel 2	0.5 V_{rms} for output impedances ≤ 1 kΩ
2	Audio input (right-hand) or channel 2	0.5 V_{rms} for input impedances ≥ 10 kΩ
3	Audio output (left-hand) or channel 1 or mono	0.5 V_{rms} for output impedances ≤ 1 kΩ
4	Audio earth	
5	Blue earth	
6	Audio input (left-hand) or channel 1 or mono	0.5 V_{rms} for input impedances impedances ≥ 10 kΩ
7	Blue component	Difference between peak value and blanking signal level = 0.7 V; load impedance = 75 Ω; superimposed d.c. voltage = 0 . . . 2 V
8	Switching voltage: 0 = TV reception 1 = operation of associated units	0 = 0 . . . 2 V 1 = 9.5 . . . 12 V at input resistance of ≥ 10 kΩ and input capacitance of ≤ 2 nF
9	Green earth	
10	Not used	
11	Green component	Identical to 7
12	Not used	
13	Red earth	
14	Not used	
15	Red component	Identical to 7
16	Blanking signal 1 = blanking	0 = 0 . . . 0.4 V 1 = 1 . . . 3 V Load resistance = 75 Ω
17	Video earth	
18	Blanking signal earth	
19	Video output	Difference between peak white level and sync signal = 1 V; Output resistance = 75 Ω; Superimposed d.c. voltage = 0 . . . 2 V Synchronization signal only = 0.3 Vpp
20	Video input	Identical to 19
21	Housing screen and/or earth	Connected to chassis

---

elektor datacard | Transistors: BD643/644/645/646/647/648/649/650/651/652



TO 220
dimensions given in mm

The BD643/645/647/649/651 transistors complement the BD644/646/648/650/652.
They are available in pairs with a maximum h_{FE} ratio of 2.5.
($|U_{CE}|$ = 3 V, $|I_C|$ = 3 A)

For the BD643/645/647/649/651 the following values apply:
$H_{FE} \geq 1500$ (typ. 1900) (U_{CE} = 3 V, I_C = 0.5 A)
$h_{FE} \geq 750$ (U_{CE} = 3 V, I_C = 3 A)
$h_{FE} \geq 750$ (U_{CE} = 3 V, I_C = 6 A)

For the BD644/646/648/650/652 the following values apply:
$H_{FE} \geq 1500$ (typ. 2500) ($-U_{CE}$ = 3 V, $-I_C$ = 0.5 A) 2)
$h_{FE} \geq 750$ ($-U_{CE}$ = 3 V, $-I_C$ = 3 A)
$h_{FE} \geq 750$ ($-U_{CE}$ = 3 V, $-I_C$ = 6 A)
$h_{FE} \geq 200$ ($-U_{CE}$ = 3 V, $-I_C$ = 8 A)
2) PNP has different characteristics to NPN.

In these transistors the COLLECTOR IS CONNECTED TO THE CASE.

Thermal resistance:
from junction the mounting base; R_{thj-mb} = 3.5 K/W
with an isolating washer but no silicone grease it becomes;
R_{thj-mb} = 4 K/W
with isolating washer and silicone grease the value is; R_{thj-mb} = 2 K/
from junction to ambient; R_{thj-a} = 70 K/W

D11

elektor contents

Elektor Publishers Ltd., Elektor House,
10 Longport, Canterbury CT1 1PE,
Kent, U.K.
Tel.: Canterbury (0227) 454439.
Telex: 965504.
Office hours: 8.30 - 12.30 and 13.30 - 16.30.

Editor: P.V. Holmes
Assistant editor: E.J.A. Krempelsauer
UK editorial staff:
R.E. Day, G.P. McLoughlin, L. Seymour
Overseas editorial staff:
P.H.M. Baggen, A. Dahmen, I. Gombos,
P.E.L. Kersemakers, R.P. Krings,
P. v.d. Linden, D.R.S. Meyer,
G.C.P. Raedersdorf, J.F. van Rooij,
G.O.H. Scheil,
Editorial secretariat:
C.H. Smeets, G.W.P. Wijnen
Head of design:
K.S.M. Walraven
Laboratory staff:
J. Barendrecht, G.H.K. Dam, K. Diedrich,
G.H. Nachbar, A. Nachtmann,
R.A.F.M. Salden, A.P.A. Sevriens,
J.P.M. Steeman, P.I.A. Theunissen
Publishing manager:
A.J. Brialey
Advertising manager:
S. Brooks

The circuits are for domestic use only. The submission of designs or articles to Elektor implies permission to the publishers to alter and translate the text and design, and to use the contents in other Elektor publications and activities. The publishers cannot guarantee to return any material submitted to them. All drawings, photographs, printed circuit boards and articles published in Elektor are copyright and may not be reproduced or transmitted in any form or by any means, including photocopying and recording, in whole or in part without prior written permission of the publishers. Such written permission must also be obtained before any part of these publications is stored in a retrieval system of any nature.

Patent protection may exist in respect of circuits, devices, components etc. described in this magazine. The publishers do not accept responsibility for failing to identify such patent or other protection.

Elektor is also published in Dutch, French, German, Greek, Italian, Portuguese, Spanish, Turkish and (in part) Swedish in association with Allt om Elektronik.

Distribution in U.K.:
Seymour Press Ltd., 334 Brixton Road,
London SW9 7AG.

Copyright © 1985 Elektor Publishers Ltd., Canterbury.

Printed in the Netherlands. ABC

Volume 11 — Number 1 **ISSN 0308-308X**

news, views, people 1-18

tea leaves 1-22
A light-hearted look at the coming decade.

selektor 1-23
Computers of the future.

Commodore cassette interface 1-25
This circuit enables Commodore's VIC20 and C64 PCs to be interfaced with virtually any cassette recorder.

VHF/UHF modulator 1-28
Improves the images obtained with PCs, video cameras, VCRs, and similar equipment.

portable guitar amplifier 1-30
A project that gives colour to the basic guitar sounds for only a modest outlay.

30 watt a.f. output stage 1-36
A good-quality power output stage suitable for use in the guitar amplifier.

JSR swap 1-40
Makes 6502-based computer systems more versatile by duplicating pages zero and one in RAM.

how to make your own PCBs 1-41

missing link 1-42

rumble detector 1-43
Detects ultra-low frequency noise that could spoil the pleasure you get from your hi-fi system.

µP-controlled frequency meter 1-46
A highly-sophisticated do-it-yourself frequency counter that compares with professional instruments in almost everything except price.

switching radio control channels 1-60
A circuit to control seven on/off functions in a radio control model that uses only a single channel in the transmitter.

applicator 1-64
20 W output amplifier based on LM1875

market 1-66

switchboard 1-71

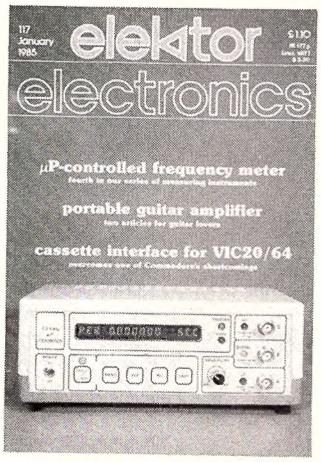
appointments 1-76

readers' services 1-80

index of advertisers 1-82

A selection from our February issue:

- RLC meter
- gyroflash
- input stage for µP-controlled frequency meter
- EPROM switchboard
- XL loudspeaker
- PCM model control


117
January
1985
elektor
electronics
µP-controlled frequency meter
portable guitar amplifier
cassette interface for VIC20/64

This month's front cover shows the µP-controlled frequency meter which continues our series of measuring instruments for the home constructor. All instruments in the series are designed to fit the same family of standard cases.

ELEKTOR BOOKS

RESI & TRANSI

A series of strip cartoons in book form in which two enterprising characters explore the field of electronics in their own inimitable way. Their adventures are full of tension, because they often go against the current — whereby they encounter much resistance — before they reach their goal. These books familiarize the reader with electronics in an unusual way: exciting, playful, yet thorough. Part I comes complete with a printed-circuit board and resimeter.

Part I: Banish the Mysteries of Electronics £6.10
Part II: Hands off my Bike! £4.80

TV GAMES COMPUTER

This book, provides a different — and, in many ways, easier — approach to microprocessors. The TV games computer is dedicated to one specific task, as the name suggests. This provides an almost unique opportunity to have fun while learning!
Price £7.10

DIGIBOOK

Provides a simple step-by-step introduction to the basic theory and application of digital electronics and gives clear explanations of the fundamentals of digital circuitry, backed up by experiments designed to reinforce this newly acquired knowledge. Supplied with an experimenter's PCB.
Price £6.30

300 CIRCUITS

For the home constructor — 300 projects ranging from the basic to the very sophisticated.
Price £5.80

DATA SHEET BOOK

Here at last is the book that designers have been waiting for: the Elektor Data Sheet Book. In 240 pages it gives you a CMOS, a Linear, Special Function and Audio Data Book: extensive information on 269 of the most important IC's. A very useful and economical reference book!
Price £8.40

JUNIOR COMPUTER BOOK 1

For anyone wishing to become familiar with (micro)computers, this book gives the opportunity to build and program a personal computer at a very reasonable cost.
Price £6.90

JUNIOR COMPUTER BOOK 2

Follows in a logical continuation of Book 1, and contains a detailed appraisal of the software. Three major programming tools, the monitor, an assembler and an editor, are discussed together with practical proposals for input and peripherals.
Price £6.90

JUNIOR COMPUTER BOOK 3

The next, transforming the basic, single-board Junior Computer into a complete personal computer system.
Price £6.90

JUNIOR COMPUTER BOOK 4

Book 4, the last in the series, describes all the software required to operate the complete system. A number of peripheral devices, such as a printer and a video terminal, may be 'hooked up' to the computer. During the final stage in its 'growth', the machine is able to extend its linguistic skills, for a special version of BASIC is now available on cassette.
Price £6.90

301 CIRCUITS

The book is a continuation of our popular and very successful 300 circuits publication. It is composed of 301 assorted circuits ranging from simple to more complex designs, described and explained in straightforward language.
Price £5.80

MICROPROCESSOR HARDWARE

This book describes a range of peripheral equipment that can be connected and used with an assortment of personal computers which use the 6502, 6809, Z80 or the 8080 CPU.
Price £7.90

JUNIOR COMPUTER VIA 6522

This book deals with the well-known Versatile Interface Adapter (VIA) type 6522. Although it is an indispensable addition to the four books already devoted to the Junior Computer, it is not aimed solely at Junior users, but at anybody who has a system with one or more 6522s. It affords a complete familiarization with this flexible and effective component.
Price £3.50

SC/MPUTER (1)

Describes how to build and operate your own microprocessor system — the first book of a series — further books will show how the system may be extended to meet various requirements.
Price £5.80

SC/MPUTER (2)

The second book in series. An updated version of the monitor program (Elbug II) is introduced together with a number of expansion possibilities. By adding the Elekterminal to the system described in Book 1 the microcomputer becomes even more versatile.
Price £5.80

FORMANT

Complete constructional details of the Elektor Formant Synthesiser — comes with a FREE cassette of sounds that the Formant is capable of producing together with advice on how to achieve them.
Price £6.30

33 ELECTRONIC GAMES

A selection of circuits which give as much enjoyment in building them as actually playing the games. The circuits are fascinating although the electronics involved are not complex and therefore anyone with a good soldering iron will find this book satisfying. These are electronic games that do not need a TV screen, and as a result can be played just about anywhere.
Price £4.80

JUNIOR PAPERWARE 1

Modifications of the PM/PME EPROM: Source listings, Hex dump of the Software cruncher and puncher (Elektor 85, May 1982)
Price £2.10

JUNIOR PAPERWARE 2

Source listing of the bootstrap loader for Ohio Scientific Floppys: Hex dump of the EPROM (ESS 515)
Price £2.10

PAPERWARE 3 & 4

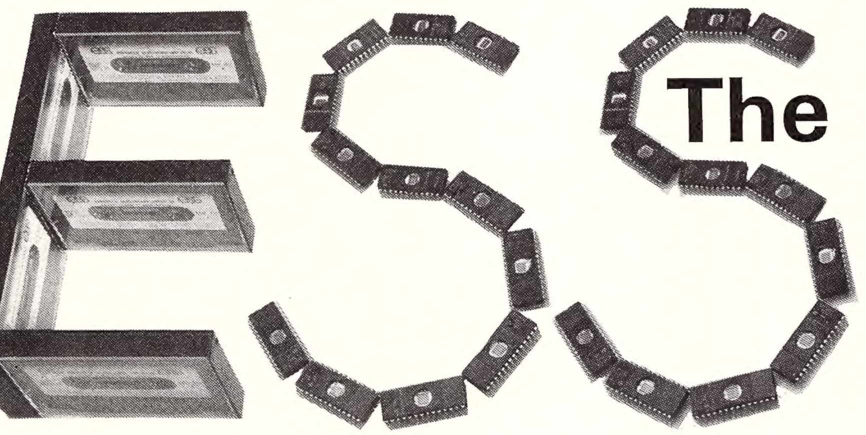
The hardware for a Universal Terminal has already been described in Elektor. It consists basically of a VDU card and a CPU card, but, of course, to make the terminal work some software is also needed. Two new books are now available to meet this need. Paperware 3 not only includes all the necessary software, but also deals with all the 'ins' and 'outs' of the terminal. Paperware 4 provides all the software and other information for using the Universal Terminal with the Junior Computer, either in expanded form or with DOS.

Price: Paperware 3 . . . . £2.70
Paperware 4 . . . . £2.80

EXTENDED PRESET UNIT FOR THE POLYPHONIC SYNTHESIZER

This book is the culmination of a project which was started in the October 1981 issue of Elektor and to which since then no fewer than nine articles have been dedicated. It is no exaggeration to say that the polyphonic synthesizer can be used to its full potential only with the extended preset unit. The booklet is divided into five distinct sections: the construction and fitting of the various cards, a functional description, calibration and testing, fault-finding, and tracking of the voltage-controlled filter and low-frequency oscillator. It is possible to build and test all the circuits and then fit them all at once into the synthesizer or build and add them piecemeal. As the booklet is intended more as a reference work than a full instruction manual, the chapters can be read in any order. The booklet assumes reasonable familiarity with computer technology.
Price £1.60

To order please use the postage paid order card in this issue.
ADD 55p P & P U.K. (OVERSEAS £1.10)



The Elektor Software Service

(see readers' service pages) gives details of TV games on cassette and on software on EPROMs.

A new addition to our series of software cassettes for the TV games computer has just become available. Like its three precedessors, the present one, number 011, offers fifteen games for the whole family.

- * Snakes and ladders — reach square 100 before your opponent(s).
- * Molebasher — catch as many moles as you can.
- * Snap — try to beat your opponent in deciding whether two pictures on the screen are identical.
- * Mazes — escape from the maze before your time is up.
- * Asteroids — try to survive for as long as possible by avoiding the asteroids.
- * Dragster — complete nine laps in the shortest possible time.
- * Omega landing — land your spacecraft in a hostile environment!
- * Break-out — twenty-four variations on 'bursting balloons' contained on cassette 010.
- * Tiny Tim — remove enough rocks and you reach the lovely girl!
- * Horse race/jackpot — two simple games of chance.
- * Newton — catch as many apples as possible.
- * Horse races — eight variations of show jumping.
- * Painting — colour the screen without being bitten.
- * Submarine/racing — two different games: in the first, the submarine tries to sink as many ships as possible; in the second, a racing car must avoid other cars on the track for as long as possible.
- * Cosmic adventure — a three-part game: first, destroy twelve meteorites; second, land under enemy fire; third, find the nuclear reactor in the underground maze.

BBC Micro Computer System

OFFICIAL DEALER

ACORN COMPUTER SYSTEMS:

BBC Model B Special offer	£320	(a)
BBC Model B + Econet	£389	(a)
BBC Model B + DFS	£399	(a)
BBC Model B + DFS + Econet	£450	(a)

UPGRADE KITS

A to B Upgrade Kit	£65	(c)
DFS Kit	£95	(c)
Econet Kit	£55	(c)
Speech Upgrade Kit	£47	(c)

ACORN ADD-ON PRODUCTS:

Z80 2nd Processor	£265	(a)
6502 2nd Processor	£175	(b)
Teletext Adaptor	£190	(b)
IEEE Interface	£280	(b)
RH Light pen	£39.50	(c)

BBC FIRMWARE:

1.2 Operating System Rom	**£7.50**	(d)
BASIC II ROM	**£22.50**	(d)
VIEW Word Processor Rom	**£48.00**	(c)
WordWise Word Processor Rom	**£34.00**	(d)
BCPL ROM/Disc	**£86.00**	(c)

Utility ROMS:

Disc Doctor/Gremlin Debug ROM	**£28 ea**	(d)
EXMON/TOOLKIT ROM	**£23 ea**	(d)
Printmaster(FX80)/Graphic ROM	**£28 ea**	(d)
ULTRACALC spreadsheet ROM	**£69 ea**	(c)

COMMUNICATION ROMS:

Termi Emulator	**£28**	(d)
Communicator	**£59**	(d)
Commstar	**£29**	(d)

In addition to products listed above we stock a wide range of BBC peripherals including: TORCH UNICORN products, GRADUATE the add on that makes the BBC micro IBM compatible, SMARTMOUTH speech synthesiser, TIME WARP Real Time Clock, Colour Graphics Plotter, Graphics Tablet, Video Digitiser, Eprom Programmer etc.

Large selection of business, pleasure and education software including CPM software for the Acorn Z80.

For detailed specification of any of the above equipment please write or telephone.

DISC DRIVES

1 × 100K Single: TS55A(40T)TEAC	**£100**	(a)
1 × 400K Single: TS55F(40/80T)TEAC	**£165**	(a)
1 × 100K Single: 3" Hitachi	**£110**	(b)
CS55A TEC with PSU	**£135**	(a)
CS55F TEC with PSU	**£169**	(a)
2 × 100K Dual: TD55A (40T) TEAC withPSU	**£275**	(a)
2 × 400K Dual: TD55F 40/80T Sw. TEAC with PSU	**£400**	(a)
2 × 400K Dual: TD55M 40/80T Sw. Mitsubishi with PSU	**£375**	(a)

All drives supplied with all necessary cables, manual and formatting disc.

3M FLOPPY DISCS

AUTHORISED 3M DISTRIBUTOR DATA RECORDING PRODUCTS

Industry standard floppy discs with a life time guarantee.

Discs in packs of 10:

40 Track SSDD	£12.50	(c)
80 Track SSDD	£21	(c)
40 Track DSDD	£17	(c)
80 Track DSDD	22	(c)

DRIVE ACCESSORIES

FLOPPICLENE Disc Head Cleaning Kit with 20 disposable, cleaning discs ensures continued optimum performance of the drives. .... **£14.50** (c)

Single Disc Cable	**£6**	(d)
10 Disc Library Case	**£1.95**	(c)
30/40 Disc Lockable Box	**£14**	(c)
Dual Disc Cable	**£8.50**	(d)
30 Disc Storage Box	**£8**	(c)
100 Disc Lockable Box	**£19**	(b)

BT APPROVED MODEMS

MIRACLE ES2000:
The ultimate world standard modem covering all common BELL and CCITT standards upto 1200 Baud. Allows communication with virtually any computer system in the world. The optional AUTO DIAL and AUTO ANSWER boards enhance the considerable facilities already provided on the modem. Mains powered. **£129** (b) Auto Dial Board/Auto Answer Board **£30** (c) each. Software lead **£4.50**

TELEMOD 2:
Complies with CCITT V23 1200/75 Duplex and 1200/1200 Half Duplex standards that allow communications with VIEWDATA services like PRESTEL. MICRONET etc as well as user to user communications. Mains powered. **£64** (b)

BUZZ BOX:
This pocket sized modem complies with V21 300/300 Baud and provides an ideal solution for communications between users, with main frame computers and bulletin boards at a very economic cost. Battery or mains operated. **£52** (c) Mains Adaptor **£8** (d)
BBC to Modem data lead **£7**

ALL PRICES EXCLUDE VAT.
Please add carriage 50p unless indicated as follows
(a) £8 (b) £2.50 (c) £1.50 (d) £1.00

PROJECTS:

Junior Computer Kit	**£86**	(b)
Housekeeper kit	**£58**	(b)
Elekterminal Kit (1980)	**£50**	(b)
ASCII Keyboard kit	**£75**	(b)
J C Books 1, 2, 3, & 4	**£6.90**	(c) ea
Universal Terminal (6502) Kit	**£75**	(b)
Elekterminal Kit (1983)	**£70**	(b)

PRINTERS

EPSON: RX80FT **£225** (a); FX80 **£312** (a); FX100 **£435** (a);
KAGA TAXAN: KP810 **£249** (a); KP910 **£369** (a);
BROTHER: HR15 **£340** (a); JUKI 6100 **£340** (a)

ACCESSORIES

EPSON Serial Interface: 8143 **£28** (b); 8148 with 2K buffer **£57** (b).

EPSON Paper Roll Holder **£17** (b); FX80 Tractor Attach **£37** (b); RX/FX80 Dust Cover **£4.50** (d).

EPSON Ribbons: MX/RX/FX80 **£5**; MX/RX/FX100 **£10** (d)

JUKI: Serial Interface **£60** (a); Tractor Attach. **£99** (a); Sheet Feeder **£199** (a); Ribbon **£2.50** (a).

BROTHER HR15: Sheet Feed **£199**; Ribbons - Carbon or Nylon **£4.75**; Multistrike **£5.50** (d); 2000 Sheets Fanfold with extra fine perf. 9.5" - **£13.50**; 15" **£17.50** (b).

BBC Parallel Lead £8; Serial Lead £7 (d).

MONITORS

ALL MONITORS SUPPLIED WITH LEAD FOR THE BBC

MICROVITEC 14" RGB
1431 Std Res **£175** (a);
1451 Med Res **£255** (a);
1451DQ3 Med Res for SINCLAIR QL **£239** (a)
1441 Hi Res **£399** (a)
1431AP std Res PAL/Audio **£215** (a);
1451AP Med Res PAL/Audio **£310** (a);
Plinth for Microvitec 14" **£8.50** (b)
Microvitec Monitors with Dual TTL/Linear inputs are also available.

KAGA 12" RGB
Hi Res VISION II **£245** (a)
Super Hi Res VISION III **£345** (a)
Hi Res 12" Green Screen Monitors:
Kaga KX1201G Anti Glare Screen **£106** (a)
Sanyo DM8112CX **£99** (a)
Kaga KX1202A Amber Screen Hi Res Monitor **£114** (a)
Swivel Stand for Kaga Green with digital clock: **£22.50** (b)
BBC Leads: Kaga RGB **£5** Microvitec **£3.50** Monochrome **£3.50** (c)

SOFTY II

This low cost intelligent eprom programmer can program 2716, 2516, 2532, 2732, and with an adaptor, 2564 and 2764. Displays 512 byte page on TV — has a serial and parallel I/O routines. Can be used as an emulator, cassette interface.

Softy II	**£195.00**	(b)
Adaptor for 2764/2564	**£25.00**	(c)

PRODUCTION PROGRAMMERS

GANG OF EIGHT
This is a smart, fast programmer with an audible alarm and a 'conversational' liquid crystal display. Single key operation discourages mistakes whilst performing BLANK CHECK, VERIFY and PROGRAM functions automatically. Programming voltage selectable 12.5/21/25 V. Will program all popular 5 V single rail eproms. It will program 8 eproms at a time **£395** (a)

P9000 Range:
These new range which will handle ALL current 5 V single rail eproms and copy 8 eproms at a time comprises of three following models:
All models have 16 character display, 10 different fault detecton features + automatic self test, 16 bit programming capability and a selection of high speed programming algorithms:

P9010: A low cost duplicator .... **£795** (a)

P9020: With serial interface with 8 different formats and 8 K buffer (expandable to 32 K) .... **£995** (a)

P9030: Top of the range with serial interface with 16 formats, baud rate upto 19.2 K, 8 K expandable buffer, editing functions. Printing facility, remote control from a computer .... **£1295** (a)

EP8000
This CPU controlled Emulator Programmer is a powerful tool for both Eprom programming and development work. EP8000 can emulate and program all eproms up to 8K × 8 bytes, can be used as stand alone unit for editing and duplicating EPROMS, as a slave programmer or as an eprom emulator
£695.00 (a)

UV ERASERS

UV1T Eraser with built-in timer and mains indicator. Built-in safety interlock to avoid accidental exposure to the harmful UV rays. It can handle up to 5 eproms at a time with an average erasing time of about 20 mins **£59 + £2 p&p**. UV12 as above but without the timer **£47 + £2 p&p**

For Industrial Users, we offer UV140 & UV141 erasers with handling capacity of 14 eproms. UV141 has a built in timer. Both offer full built in safety features UV140 **£61**, UV141 **£79, p&p £2.50**

PROGRAMMED ROMS FOR ELEKTOR PROJECTS

503-N Jnr. Computer Monitor	2708	**£ 4.80**
504 Disco lights	2708	**£ 4.80**
505 Chess Intelekt	2 × 2716	**£14.60**
506 J C Tape Monitor	2716	**£ 7.30**
507-N J C Printer Mon & PME	2716	**£ 7.30**
508 J C Bus Control	82S23	**£ 4.80**
510 150 MHz Freq Meter	2 × 82S23	**£ 9.60**
514 Dark Room Computer	2716	**£ 7.30**
516 Talking Dice	2716	**£ 7.30**
521 CharGen & Video Routine for DOS Junior	2732 + 2716	**£16.40**
522 CharGen & video; Routine for extended junior	2732 + 2 × 2716	**£24.00**
523 Char. Generator	2732	**£ 9.00**
524 Quantisizer	2732	**£ 9.00**
525 Universal Term.	2732	**£ 9.00**
526 Wind Dir Ind	2716	**£ 7.30**
527 Elabyrinth	2716	**£ 7.30**
530 Daisywheel Iface	2732	**£ 9.00**

SEE OUR INSIDE FRONT COVER PAGE ADVERTISEMENT FOR COMPONENT PRICES

TECHNOMATIC LTD

MAIL ORDERS TO: 17 BURNLEY ROAD, LONDON NW10 1ED
SHOPS AT: 17 BURNLEY ROAD, LONDON NW10
(Tel: 01 208 1177, Telex: 922800)
305 EDGWARE ROAD, LONDON W2

PLEASE ADD 50p p&p & 15% VAT
(Export: no VAT, p&p at Cost)
Orders from Government Depts. & Colleges etc. welcome
Detailed Price List on request
Stock items are normally by return of post

WATFORD ELECTRONICS

34/35 CARDIFF ROAD, WATFORD, HERTS, ENGLAND
MAIL ORDER, CALLERS WELCOME
Tel. Watford (0923) 37774/40588. Telex: 8956095

ALL DEVICES FULLY GUARANTEED. Send Cheque, P.O.s, Cash or Bank Draft with orders. TELEPHONE ORDERS BY ACCESS/MASTERCHARGE ACCEPTED. Government & Educational Establishments official orders welcome. P&P add 75p to all CASH orders. Overseas orders, postage at cost. Prices subject to change without notice. Orders normally despatched by return post.

VAT Export orders no V.A.T. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of V.A.T. Please add 15% to the total cost including P&P.
We stock thousands more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street.
Open Monday to Saturday: 9.00 am to 6.00 pm. Ample Free Car Parking space available.

ELECTROLYTIC CAPACITORS: (Values in µF **500V**: 10µF **52p**; 47 **78p**; **63V**; 0.47, 1.0, 1.5, 2.2, 3.3, 4.7 **8p**; 10 **10p**; 15, 22 **12p**, 33 **15p**; 47 **12p**; 68 **20p**; 100 **19p**; 220 **26p**; 1000 **70p**; 2200 **99p**; **50V**: 68 **20p**; 100 **17p**; 220 **24p**; **40V**: 6.8 **15p**; 22 **9p**; 33 **12p**; 330, 470 **32p**; 1000 **48p**; 2200 **90p**; **25V**: 1.5, 4.7, 10, 22, 47 **8p**; 100 **11p**; 150 **12p**; 220 **15p**; 330 **22p**; 470 **25p**; 680, 1000 **34p**; 1500 **42p**; 2200 **50p**; 3300 **76p**; 4700 **92p**; **16V**: 47, 68, 100 **9p**; 125 **12p**; 330 **16p**; 470 **20p**; 680 **34p**; 1000 **27p**; 1500 **31p**; 2200 **36p**; 4700 **79p**.

TAG-END CAPACITORS: 64V : 2200 **139p**; 3300 **198p**; 4700 **245p**; **50V**: 2200 **110p**; 3300 **154p**; **40V**: 4700 **180p**; **25V**: 2200 **90p**; 3300 **98p**; 4000, 4700 **98p**; 10,000 **320p**; 150,000 **345p**; 22,000 **360p**; 16V

POLYESTER CAPACITORS: **Axial Lead Type**
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8 **11p**; 10n, 15n, 8n, 22n, **12p**; 33n, 47n, 68n **16p**; 150n **20p**; 220n **30p**; 330n **42p**; 470n **52p**; 680n 1µF **68p**; 2µ2 **82p**.
160V: 10nF, 12n, 39n **11p**; 150n, 220n **17p**; 330n, 470n **30p**; 680n **38p**; 1µF **48p**; 1µ5 **45p**; 2µ2 **48p**; 4µ7 **58p**.
1000V: 1nF **17p**; 10nF **30p**; 15n **40p**; 22n **36p**; 33n **42p**; 47n, 100n **42p**.

SIEMENS pcb
Type Miniature poly Capacitors
250V

1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10n, 15n,	**7p**
18n, 22n, 27n, 33n, 39n, 47n	**8p**
39n, 56n	2p
82n, 100n	**11p**
100V	
110n, 100n	**10p**
150n, 180n	**12p**
220n, 270n	**12p**
330n, 390	**20p**
470n, 560n	**26p**
680r	**30p**
1uF 34p 2u2	**50p**

POLYESTER RADIAL LEAD CAPACITORS: 250 V
10n, 15n, 27n **6p**; 33n, 47n, 68n, 100n **8p**; 150n, 220n **10p**; 330n, 470n **15p**; 680n **19p**; 1u **23p**; 1u5 **40p**; 2u2 **46p**.

FEED-THROUGH CAPACITORS
1000pF/450V **10p**

TANTALUM BEAD CAPACITORS
35V: 0.1µF, 0.22, 0.33 **15p**; 0.47, 0.68, 1.0, 1.5 **16p**; 2.2, 3.3 **18p**; 4.7, 6.8 **22p**; 10 **28p**; **16V**: 2.2, 3.3 **16p**; 4.7, 6.8, 10 **18p**; 15 **36p**; 22 **45p**; 33, 47 **50p**; 100 **95p**; **10V**: 15, 22 **26p**; 33, 47 **50p**; 100 **80p**; **6V**: 100 **55p**.

POTENTIOMETERS: Rotary, Carbon, Track 0.25 W Log & Lin Values.
500 Ω, 1 KΩ & 2KΩ (Linear only)

Single-Gang	**35p**
5 KΩ-2 MΩ Single Gang Log & Lin	**35p**
5 KΩ-2MΩ Single Gang D/P Switch	**95p**
5 KΩ-2MΩ Double Gang	**99p**

MYLAR FILM CAPACITORS
100V: 1nF, 2.4, 4nF, 10 **6p**; 15nF, 22n, 30n, 40n, 47n **7p**; 56n, 100n, 200n **9p**; **50V**: 470nF **12p**.

SLIDER POTENTIOMETERS

0-25 W log and linear values 60 mm	
5 KΩ-500 KΩ single gang	**80p**
Self Stick Graduated Bezel	**45p**

CERAMIC CAPACITORS 50V:
Range: 0-5pF to 10nF **4p**; 15nF, 22nF, 33nF, 47nF **5p**; 100nF/30V **7p**; 200nF/6V **8p**.

POLYSTYRENE CAPACITORS:
10pF to 1nF **8p**; 1.5nF to 12nF **10p**.

PRESET POTENTIOMETERS

0.1W 100Ω - 5MΩ Miniature	
Vertical or Horizontal	**8p**
0.25W 100Ω - 3.3MΩ horiz. larger	**12p**
0.25W 00Ω - 4.7MΩ vert.	**12p**

ACCESS

Orders
Just phone your orders through.
We do the rest
Tel: 0923 50234

SILVER MICA (Values in pF)

2, 3.3, 4.7, 8.2, 10, 12, 15, 18, 22, 27, 33, 39, 47, 50, 56, 68, 75, 82, 85, 100, 120, 150, 180pF	**15p each**
220, 220, 250, 270, 300, 330, 360, 390, 470, 800, 820	**21p each**
1000, 1200, 1800, 2200	**30p each**
3300, 4700pF	**60p each**

DRAM 256K - 150nS £49

MINIATURE TRIMMERS Capacitors
2-6pF, 2-10pF **22p**; 2-25pF, 5-60pF **30p**; 10-88pF **35p**.

RESISTORS

miniature Carbon Film Hi-Stab. 5%

	RANGE	VAL	1 - 99	100 +
0.25W	2Ω2 - 4M7	E24	3p	1p
0.5W	2Ω2 - 4M7	E12	3p	1p
1W	2Ω2 - 4M7	E12	6p	4p
1% Metal Film		E24	5p	4p

100 + price applies to Resistors of each type not mixed.

RESISTORS Network S.I.L.
7 Commoned: (8 pins) 100Ω, 6800Ω, 1K, 2k2, 4K7, 10K, 47K, 100K **25p**
8 Commoned: (9 pins) 150Ω, 180Ω, 270Ω, 330Ω, 1K, 2k2, 4K7, 10K, 22K, 47K & 100K **26p**

DIODES

AA119	15
AA129	20
AAY30	15
BA100	15
BAX13	20
BY100	24
BY126	12
BY127	14
CRO33	250
OA9	40
OA47	12
OA70	12
OA79	15
OA81	20
OA85	15
OA90	8
OA91	8
OA95	8
OA200	8
OA202	8
1N914	4
1N916	5
1N4001/2	5
1N4003	6
1N4004/5	6
1N4006/7	7
1N4148	4
1N5401	15
1N5404	16
1N5406	17
1N5408	19
1S44	9
1S921	9
6A/100V	40
6A/400V	50
6A/800V	65

VARI-CAPS

BA102	50
BB105B	40
BB106	40
BB109B	45
MVAM2	165

BRIDGE rectifiers

1A/50V	18
1A/100V	20
1A/400V	25
1A/600V	34
2A/50V	30
2A/200V	40
2A/400V	46
2A/600V	65
6A/100V	83
6A/400V	95
10A/200V	215
10A/600V	298
25A/200V	240
25A/600V	395
BY164	56
VM18 DIL	50

ZENERS

Range: 2V7 to 39V 400mW **8p each**
Range: 3V3 to 33V. 1.3W **15p each**

TRIACS

3A 200V	54
3A 400V	56
8A 100V	60
8A 400V	69
8A 800V	115
12A 100V	78
12A 400V	82
12A 800V	135
16A 100V	103
16A 400V	106
16A 800V	220
25V 500V	220
25A 800V	295
T2800D	125

DIAC

ST2	25

75 SERIES

75107/8	95
75110	90
75114/5	150
75121/2	130
75150	125
75154	125
75158	150
75195	195
75182/3	99
75188/9	100
75322	140
75324	360
75325	00
75365	00
75450	86
75451/2	52
75454	70
75491/2	65

SCR THYRISTORS

5A/40V	32
5A 400V	40
5A 600V	48
8A 300V	60
8A 600V	90
12A 100V	78
12A 400V	96
12A 800V	188
BT106	150
BT116	180
C106D	38
TIC44	24
TIC45	29
TIC47	35
2N5062	32
2N5064	38
2N4444	130

COMPUTER ICs

2114L-4	325
2147	395
2516	350
2532	350
2564	700
27L08	450
2716-5V	350
2732-4	450
2764-250	475
27C64	1095
27128-250	£16
3242	590
4027	100
4116	125
4164-150	450
41256	£48
4416	595
4532-3	250
4816-100n	250
6116-150	475
6116L-120	525
6117-100n	525
6264	£28
6264L-15	£28
63A03	£14
6502A	545
6502CPU	355
6503	600
6504-250	550
6505	600
6520 PIA	175
6522 VIA	340
6530	£11
6532	650
6545 RTC	899
6551 ACIA	650
6800	220
6802	275
6803	850
6804	160
6805	670
6808	520
6809	650
6810	175
6821	175
68B21	220
6840	375
6843	£12
6845	650
6845SP	750
6846	625
6847	650
6850	175
6852	250
6854	650
68B54	800
6875	500
68000	£30
8035	600
8080A	425
8085A	950
8088	1750
8123	160
8131	475
8155	745
8156	650
81LS95	175
81LS96	175
81LS97	175
81LS98	175
8202	£25
8212	495
8214	495
8216	390

8224	350
8225	£11
8226	350
8228	270
8243	550
8250	£11
8251A	795
8253	750
8255	650
8256 AC	£15
8257 A	400
8259	700
8271	P.O.A.
8272	£25
8279	750
8282	450
8283	00
8284	550
8285	365
8287	00
8288	£11
8303	450
8304	350
8T26A	99
8T27	150
8T31	350
8T95	90
8T97N	90
9602	220
AM26LS31C	125
AM26LS33	150
AM7910	£30
AY-5-1013	300
CD4724	150
COM8017	275
COM8116	700
D8748	£55
DM8131	475
DS3691N	595
DS88LS120	495
DS8820	110
DS8830	198
DS8831	125
DS8832	250
E9364	800
E9365	£36
FD1691	£15
FD1771	£15
FD1791	£22
FD1793	£23
FD1795	£28
FD1797	£28
FD1799	£28
HD26501	75
HM6845	755
IM6402	350
INS8060N	1250
INS8154N	£9
MC1488	100
MC1489	100
MC14411	690
MC14412	725
MC3446	250
MC3447P	315
MC3486	225
MC3487	225
MC6845	625
MC6846	625
MK3886-2M	£7
MM5280D	695
MM5303	635
MM5307	1275
MM5387A	865
MM58174	875
MM74C922	750
RO-3-2513L	700
RO-3-2513U	750

SAA5050	875
SFF9634E	800
SPO256AL2	495
TCM3101J	£13
TMS2716	725
TMS4164	395
TMS4416-2	595
TMS4500	£12
TMS5100	600
TMS9927	£14
TMS9928	£20
TMS9929	£20
TMS9995	£12
UPD7002	725
UPD7007	725
WD1691	£14
WD1770	1995
WD2143	850
Z80CPU 2.5M	300
Z80A CPU4M	375
Z80 CTC	285
Z80A CTC	335
Z80B	£11
Z80 DART	698
Z80A DART	820
Z80 ADMA	925
Z80 DMA	795
Z80 PIO	325
Z80 A PIO	350
Z80 SIO-1	850
Z80 A SIO	£9
Z80 AS10-2	£9
Z8002 CPU	00

LINEAR ICs

555CMOS	95
702	75
709C 8 pin	35
710	48
741-8 pin	16
747C 14 pin	70
748C 8 pin	30
753 8 pin	185
810	159
9400CJ	375
AY-1-1320	225
AY-1-5050	99
AY-1-5051	160
AY-16720	210
AY-3-1270	730
AY-3-1350	350
AY-3-8910	390
Booklet for AY-3-8910	200
AY-3-8912	500
AY-5-1317A	630
AY-5-1350	388
CA3011	130
CA3012	175
CA3014	275
CA3018	86
CA3019	80
CA3020	210
CA3023	210
CA3028A	110
CA3035	255
CA3036	270
CA3043	275
CA3045	385
CA3046	70
CA3048	220
CA3059	325
CA3075	213

CA3080E	75
CA3081	190
CA3085	160
CA3086	60
CA3089E	215
CA3090AQ	375
CA3123E	165
CA3130	90
CA3140	50
CA3160	95
CA3161	160
CA3162	450
CA3189	275
FC347	175
FC353	175
FC525	525
HA 1336W	240
HA1388	235
ICL7106	690
ICL7107	975
ICL7611	99
ICL7660	248
ICL8038C	360
ICL8211A	175
ICM7205A	1150
ICM7207	475
ICM7215	1050
ICM7216AJ	£22
ICM7216B	£22
ICM7216C	£22
ICM7217A	750
ICM7224	£11
ICM7240	300
ICM7555	105
ICM7556	150
LA3350	250
LA4031P	340
LA4032	295
LA4400	350
LA4422	320
LC7120	300
LC7130	320
LC7137	350
LF347	150
LF351	70
LF353	90
LF355	90
LF356	90
LF357	100
LF398	495
LM10	325
LM301A	30
LM307	45
LM308T	75
LM311	60
LM318N	175
LM319	180
LM324A	45
LM334Z	115
LM335Z	135
LM337	275
LM339	40
LM348	60
LM349	125
LM358	50
LM377	210
LM379	495
LM380	120
LM381N	175
LM382	200
LM384	225
LM386	110
LM387	200
LM389	160
LM393	85
LM394CH	385
LM558	170
LM725CN	300
LM733	65
LM1458	45
LM1871	300
LM1875	475
LM1889	350
LM2907	395
LM2917	325
LM3900	70
LM3909N	100
LM3911	185
LM3914	300
LM3915	300
LM3916	300
LM13600	150
LS7220	280
M51513L	230
M51515L	320
M51516L	475
MB3712	200

MB3712	200
MB3756	440
MC1204	250
MC1301	90
MC1303	98
MC1304P	260
MC1310P	150
MC1445	250
MC145106	695
MC1455	50
MC1458	35
MC1469	300
MC1494	694
MC1495	350
MC1496L	70
MC1596	225
MC1648	290
MC1709G	90
MC3302	75
MC3401	50
MC3403	95
MC3404	85
MC3405	150
MC3422	00
MC3423	80
MC3442	00
MC3487	00
MC4016	00
MF10	350
MFC6040	75
ML924	275
NE515	275
NE529	225
NE531	160
NE543K	225
NE544	200
NE555	25
NE556	65
NE560	350
NE562B	410
NE564	420
NE565A	120
NE566	155
NE567V	140
NE570	410
NE571	400
NE5532	175
NE5534A	160
OM335	750
RC4136D	60
RC4558	60
S566B	225
SAB3209	425
SAB3210	325
SAB3271	485
SAB4209	595
SG3402	295
SL490	350
SL6270CD	150
SN76013	350
SN76023ND	240
SN76033	350
SN76227N	95
SN76477	470
SN76488	525
SP8629	350
SPO256AL	495
TA7120	140
TA7130	150
TA7204	150
TA7205	90
TA7222	150
TAA621AX1	295
TAA661A	190
TAA700	275
TAA900	395
TAD100	159
TBA120S	70
TBA540Q	275
TBA550Q	330
TBA641BX or BX11	290
TBA651	190
TBA800	80
TBA810	95
TBA820	80
TBA920Q	200
TBA950	300
TBA990Q	350
TBA540	275
TCA220	350
TCA270Q	350
TCA280A	220
TCA965	180
TDA1008	310
TDA1010	235
TDA1022	499

TDA1024	115
TDA1034	350
TDA1490	350
TDA2002	325
TDA2003	198
TDA2004	300
TDA2006	330
TDA2020	320
TDA2030	190
TDB0701	420
TL170	50
TL430	90
TL507	110
TL509	110
TLO61CP	40
TLO62CP	65
TLO64CN	98
TLO71CP	40
TLO72CP	76
TLO74CN	150
TLO81CP	35
TLO82CP	60
TLO83CP	75
TLO84CN	120
TLO91CP	60
UA2240	120
UA78540	230
UAA170	170
UAA180	180
ULN2003	90
ULN2004	90
ULN2283	100
ULN2803	190
UPC575	275
UPC1025H	375
UPC1156H	295
UPC1181	425
UPC1182	425
UPC1366	195
XR2206	375
XR2207	400
XR2211	575
XR2216	675
XR2266	360
ZN414	80
ZN419E	180
ZN423E	130
ZN424E	130
ZN425E	595
ZN426E	300
ZN427E	600
ZN428E	450
ZN429E	245
ZN459	615
ZN1034E	200
ZN1040E	665
ZNA234E	925

TRANSISTORS

AD142	120
AD149	79
AD161	42
AD162	42
AF118	80
AF139	40
AF239	55
BC107	12
BC107B	14
BC108	12
BC108B	14
BC108C	14
BC109	12
BC109B	14
BC109C	14
BC114/5	30
BC117/8	25
BC137/9	40
BC140	38
BC142/3	38
BC147	12
BC147B	15
BC148	12
BC148B	15
BC149	12
BC149C	15
BC153/4	30
BC157/8	14
BC159	11
BC160	46
BC167A	14
BC168C	12
BC169C	12
BC170	20
BC171/2	12
BC173	15
BC177/8	16
BC179	20

BC181	30
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC186/7	28
BC212	10
BC212L	12
BC213	10
BC213L	12
BC214	10
BC214L	12
BC237/8	15
BC256B	35
BC307B	15
BC308	16
BC318	30
BC327/8	15
BC337/8	15
BC441/61	34
BC477	40
BC516/7	40
BC547/8	12
BC549C	15
BC556/7	15
BC558/9	15
BCY41/42	30
BCY58/59	36
BCY70/71	18
BCY72	25
BCY78	30
BD121	96
BD124	115
BD131/32	65
BD133	70
BD135	46

BD136/37	40
BD138/39	40
BD140	40
BD144	190
BD158	68
BD205/6	110
BD245	65
BD378	70
BD434	70
BD517	75
BD645	80
BD695A	150
BD696A	150
BF115	45
BF154/8	30
BF167	35
BF173	35
BF177	35
BF178	35
BF179	40
BF184/5	38
BF194/5	12
BF198/9	18
BF200	80
BF224A	40
BF224B	40
BF245	50
BF256A	45
BF256B	50
BF257/8	32
BF259	40
BF275	55
BF336/7	35
BF494/5	40
BFR39/40	25
BFR41/79	25
BFR80/81	25
BFR98	106
BFX29	35
BFX81	45

BFX84	35
BFX85/6	35
BFY50/51	30
BFY52	30
BFY53	35
BFY55/6	35
BFY64	40
BFY81	120
BFY90	80
BFY39	50
BSX20	30
BSX26/29	45
BSY26	35
BSY95	35
BU105	180
BU205	190
BU206	200
BU208	200
BUY69C	225
MJ2955	90
MJE170	150
MJE180	150
MJE340	54
MJE370	100
MJE371	100
MJE520	96
MJE521	96
MJE2955	99
MJE3055	70
MPF102	40
MPF103	30
MPF104	30
MPF105	30
MPF106	40
MPSA05	30
MPSA08	30
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	40

MPSU02	58
MPSU05	60
MPSU06	60
MPSU52	65
MPSU55	60
MPSU56	60
TIP29A	32
TIP29C	38
TIP30A	35
TIP30C	37
TIP31A	38
TIP31B	39
TIP31C	45
TIP32A	43
TIP32C	45
TIP33A	70
TIP33C	75
TIP34A	85
TIP34C	105
TIP35A	120
TIP35C	130
TIP36A	130
TIP36C	140
TIP41A	50
TIP41B	52
TIP42A	55
TIP42B	58
TIP120	70
TIP121/2	73
TIP141/2	120
TIP147	120
TIP2955	70
TIP3055	70
TIS44/5	45
TIS /74	50
TIS88A	50
TIS90/91	30
UC734	65
VK1010	99
VN10KM	70

VN46AF	95
VN66AF	110
VN88AF	120
VN89AF	120
ZTX300	13
ZTX301	16
ZTX302	16
ZTX303	25
ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX451	23
ZTX500	14
ZTX501/2	15
ZTX503	18
ZTX504	25
ZTX531	25
ZTX550	25
2N697	23
2N698	40
2N699	48
2N707a	25
2N708	25
2N918	40
2N1131/2	40
2N1671b	160
2N2160	325
2N2219a	28
2N2220a	26
2N2221a	26
2N2222	25
2N2368	25
2N2369A	18
2N2483/A	27
2N2646	46
2N2904/5	28
2N2907	28
2N2926	10
2N3053	25

2N3055	50
2N3614	180
2N3702/3	10
2N3819	35
2N3820	60
2N3822	60
2N3904	18
2N3906	18
40673	75

RF CHOKES Miniature PCB type

1uH, 2u2, 4u7, 10u, 22u, 33u, 47u, 100u, 220u, 330u, 470u,	**30p**
1mH, 1m5, 2m2, 4m7, 10mH,	**35p**
22m, 33m, 43m,	**60p**
100m	**75p**

TTL74

7400	25
7401	25
7402	25
7403	25
7404	30
7405	30
7406	40
7407	40
7408	25
7409	25
7410	25
7411	25
7412	25
7413	50
7414	60
7416	35
7417	35
7420	25
7421	50
7422	40
7423	35
7425	35
7426	40
7427	35
7428	35
7430	25
7432	30
7433	30
7437	30
7438	40
7440	30
7441	90
7442	65
7443	150
7444	100
7445	110
7446	110
7447	95

7448	110
7450	30
7451	30
7453	30
7454	30
7460	30
7470	50
7472	50
7473	50
7474	45
7475	55
7476	45
7480	60
7481	175
7482	100
7483	100
7484	105
7485	100
7486	40
7489	200
7490	60
7491	70
7492	70
7493	50
7494	100
7495	60
7496	75
7497	200
74100	175
74104	70
74105	70
74107	45
74109	70
74110	55
74111	55
74116	160
74118	100
74119	160
74120	90
74121	45
74122	65
74123	75
74125	60
74126	60
74128	55
74132	70
74136	50
74141	85
74142	235
74143	250
74144	250
74145	100
74147	160
74148	130
74150	170
74151	60
74153	70
74154	130
74155	75
74156	90
74157	75
74159	170
74160	100
74161	100
74162	100
74163	100
74164	110
74165	100
74166	130
74167	250
74170	190
74172	400
74173	130
74174	100
74175	100
74176	100
74177	110
74178	130
74179	130
74180	100
74181	300
74182	120
74184	170
74185	170
74190	120
74191	120
74192	120
74193	120
74194	100
74195	75
74196	120
74197	100
74198	200
74199	200
74221	200
74246	130
74247	120

74248	145
74249	175
74251	90
74259	150
74265	260
74273	180
74276	130
74278	160
74279	80
74283	100
74284	440
74285	300
74286	90
74290	80
74293	80
74297	175
74298	160
74351	180
74365	70
74366	70
74367	70
74368	70
74376	120
74390	100
74393	100
74425	60
74426	60
74490	100

74C

74C244	150
74C245	150
74C373	180
64C374	425
74C922	625
74C923	645
74C925	650

74S

74S00	40
74S02	40
74S03	40
74S04	40
74S05	40
74S08	40
74S09	40
74S10	40
74S11	40
74S15	60
74S20	40
74S22	40
74S30	60
74S32	50
74S37	50
74S38	70
74S40	40
74S51	40
74S64	40
74S65	40
74S74	70
74S85	295
74S86	100
74S112	100
74S113	100
74S114	100
74S124	300
74S132	90
74S133	50
74S134	60
74S135	110
74S138	170
74S139	170
74S140	60
74S151	140
74S153	140
74S153	140
74S157	200
74S158	190
74S162	300
74S163	300
74S168	300
74S169	300
74S174	250
74S175	300
74S181	£11
74S182	250
74S188	200
74S189	225
74S194	280
74S195	320
74S196	395
74S197	300
74S201	250
74S225	500
74S226	350
74S240	375
74S241	375
74S244	474

74S251	225
74S257	225
74S258	225
74S260	70
74S262	£10
74S274	£10
74S275	£10
74S280	425
74S281	885
74S283	295
74S287	200
74S288	180
74S289	200
74S299	595
74S301	350
74S365	250
74S373	375
74S374	375
74S381	550
74S412	380
74S470	325
74S471	600
74S472	400
74S474	400
74S475	425
74S571	300
74S573	450

74LS

74LS00	25
74LS01	25
74LS02	25
74LS03	25
74LS04	25
74LS05	25
74LS08	25
74LS09	25
74LS10	25
74LS11	25
74LS12	25
74LS13	35
74LS14	55
74LS15	25
74LS20	25
74LS21	25
74LS22	25
74LS24	55
74LS26	25
74LS27	25
74LS28	25
74LS30	25
74LS32	50
74LS33	25
74LS37	25
74LS38	30
74LS40	25
74LS42	55
74LS47	90
74LS48	90
74LS49	100
74LS51	30
74LS54	30
74LS55	30
74LS63	55
74LS73	30
74LS74	35
74LS75	45
74LS76	40
74LS78	40
74LS83	70
74LS85	80
74LS86	35
74LS90	50
74LS91	90
74LS92	55
74LS93	50
74LS95	70
74LS96	90
74LS107	45
74LS109	45
74LS112	45
74LS113	40
74LS114	40
74LS122	70
74LS123	100
74LS124	125
74LS125	50
74LS126	50
74LS132	60
74LS133	50
74LS136	50
74LS138	60
74LS139	60
74LS145	115
74LS147	165
74LS148	130
74LS151	70
74LS153	70

74LS154	20
74LS155	7
74LS156	7
74LS157	6
74LS158	6
74LS160	7
74LS161	7
74LS162	7
74LS163	7
74LS164	8
74LS165	11
74LS166	15
74LS168	14
74LS169	12
74LS170	16
74LS173	10
74LS174	10
74LS175	7
74LS181	19
74LS183	19
74LS190	8
74LS191	8
74LS192	8
74LS193	8
74LS194	7
74LS195	7
74LS196	8
74LS197	8
74LS221	8
74LS240	9
74LS241	9
74LS242	9
74LS243	9
74LS244	9
74LS245	1
74LS247	1
74LS248	1
74LS249	1
74LS251	
74LS253	
74LS257	
74LS258	
74LS259	1
74LS260	
74LS261	1
74LS266	
74LS273	1
74LS275	3
74LS279	
74LS280	1
74LS283	
74LS290	
74LS292	8
74LS293	
74LS295	1
74LS297	8
74LS298	1
74LS299	2
74LS320	2
74LS323	3
74LS324	1
74LS347	
74LS348	
74LS352	
74LS353	
74LS356	
74LS363	
74LS364	
74LS365	
74LS366	
74LS367	
74LS368	
74LS373	
74LS374	
74LS375	
74LS377	
74LS378	
74LS379	
74LS384	
74LS385	
74LS386	
74LS390	
74LS393	
74LS395	
74LS398	
74LS399	
74LS447	
74LS465	
74LS490	
74LS540	
74LS541	
74LS624	
74LS629	
74LS640	
74LS641	
74LS645	
74LS668	
74LS669	
74LS670	
74LS673	
74LS674	
74LS682	
74LS684	
74LS687	

SWITCHES

Toggle: 2 A, 250 V

SPST	35p
DPDT	48p

SUB-MIN-TOGGLE

SPST on/off	58p
SPDT c/over	64p
SPDT centre off	85p
SPDT biased both ways	105p
DPDT 6 tags	80p
DPDT centre off	88p
DPDT biased both ways	145p
DPDT 3 positions' on/on/on	185p
4-pole 2 way	220p

SLIDE 250 V:

DPDT 1 A	14p
DPDT 1 A c/off	15p
DPDT ½ A	13p

PUSHBUTTON 6 A
with 10 mm Button

SPDT latching	150p
DPDT latching	200p
SPDT moment	150p
DPDT moment	200p

Mini Non Locking

Push to Make	**15p**
Push to Break	25p

DIGITAST SWITCHES
Assorted colours
75p each

DIL SWITCHES

(SPST) 4 way **65p** 6 way **80p**
8 way **85p** 10 way **100p**
(SPDT) 4 way **190p**

ROTARY SWITCHES

(Adjustable Stop type)
1 pole/2 to 12 way; 2p/2 to 6 way; 3 pole/2 to 4 way; 4p/2 to 3 way **48p**

ROTARY: Mains: DP 250 V 4 Amp on/off **68p**

ROTARY: (Mak-a-Switch) Make a multiway switch. Shafting assembly has adjustable stop. Accommodates up to 6 wafers (max. 6 pole/12 way + DP switch).
Mechanism only **90p**

WAFERS: (make before break) to fit the above switch mechanism.
1 pole/12 way; 2 pole/6 way; 3 pole/4 way; 4 pole/3 way; 6-/2 way **65p**
Mains DP 4A Switch to fit **45p**
Spacers **4p**. Screen **8p**

ROCKER SWITCHES

ROCKER: 5A/250V SPST	28p
ROCKER: 10A/250V SPDT	38p
ROCKER: 10A/250V DPDT c/off	95p
ROCKER: 10A/250V DPST with neon	85p

THUMBWHEEL SWITCH
Mini front mounting

Decade Switch Module	275p
B.C.D. Switch Module	298p
Mounting Cheeks (per pair)	75p

VEROBOARD 0.1 in

	clad	plain
2½ × 3¼	95p	—
2½ × 5"	110p	—
3¾ × 3¾	110p	—
3¾ × 5"	125p	—
3¾ × 17"	420p	198p
4¾ × 17"	590p	275p
Pkt. of 100 pins		55p
Spot face cutter		150p
Pin insertion tool		185p

VQ Board	195p
DIP Board	395p
Vero Strip	95p

PROTO DECs

Veroblock	**480p**
S-Dec	**360p**
Eurobreadboard	**590p**
Bimboard 1	**575p**
Superstrip SS2	**1360p**

VERO WIRING

PEN + spool	**380p**
Spare spool	**75p**
Combs	**6p**

DALO ETCH RESIST PEN
Plus spare tip **100p**

FERRIC CHLORIDE
1 lb bag Anhydrous
195p + 50p P&P

ULTRASONIC TRANSDUCER
40 kHz **395p**

COPPER CLAD BOARDS

Fibre glass	Single-sided	Double-sided
6" × 6"	100p	125p
6" × 12"	175p	225p

DIL SOCKETS

	Low Prof	Wire Wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	20p	60p
22 pin	22p	65p
24 pin	25p	70p
28 pin	28p	80p
40 pin	30p	99p

EDGE CONNECTORS

2 × 18 way	210p
2 × 22 way	215p
2 × 23 way	175p
2 × 25 way	285p
2 × 28 way	190p
2 × 30 way	310p
2 × 36 way	360p
2 × 40 way	380p
2 × 43 way	450p
2 × 75 way	650p

ANTEX SOLDERING IRON

C-15W	525p	CS17W	550p
G-18W	560p	XS25W	575p

Spare tips, assorted size	85p
Spare Elements	230p
Iron stand with sponge	175p

SIL SOCKET
0.1" pitch
20 way
65p

IDC CONNECTORS

PCB Plugs with latch	Pins Strt	Pins Angle	Female Header Plug	Female Card Edge Connect
10 way	90p	99p	85p	120p
16 way	130p	150p	110p	—
20 way	145p	166p	125p	195p
26 way	175p	200p	150p	240p
34 way	206p	236p	169p	320p
40 way	220p	250p	190p	340p
50 way	236p	270p	200p	395p
60 way	—	—	230p	495p

EURO CONNECTORS

	Female Strt. Pins	Socket Angle Pins	Male Strt Pins	Plug Angle Pins
DIN41617 31 way	170p	—	—	175p
DIN41612 2 × 32 A + B	275p	320p	220p	285p
DIN41612 2 × 32 A + C	295p	340p	240p	300p
DIN41612 3 × 32 A + B + C	360p	360p	260p	395p

DIL PLUG
(Header)

	Solder	IDC
14pin	40p	99p
16pin	49p	106p
24pin	88p	178p
28pin	185p	290p
40pin	250p	255p

ZIF TEXTOOL DIL SOCKETS

24 pin	575p
28 pin	695p
40 pin	845p

RIBBON CABLE
price per foot

		Grey Colour
10 way	15p	28p
16 way	25p	40p
20 way	30p	50p
24 way	40p	65p
28 way	55p	80p
34 way	60p	85p
40 way	70p	90p
50 way	85p	110p
64 way	100p	135p

PANEL METERS
FSD
60 × 46 × 35mm
0-50µA
0-100µA
0-500µA
0-1mA
0-5mA
0-10mA
0-50mA
0-100mA
0-500mA
0-1A
0-2A
0-25V
0-50V AC
0-300V AC
"S"
"VU"
475p each

CRYSTALS

32.768KHz	100
100KHz	545
200KHz	370
455KHz	370
1MHz	275
1.008M	275
1.28MHz	450
1.5MHz	525
1.6MHz	595
1.8MHz	545
1.8432M	250
2.0MHz	225
2.4576M	200
3.278M	150
3.5794M	96
3.6864M	300
4.0MHz	150
4.032MHz	290
4.194304M	200
4.433619M	100
4.80MHz	200
5.0MHz	160
5.185MHz	300
5.24288M	390
6.0MHz	140
6.144MHz	150
6.5536MHz	225
7.0MHz	150
7.168MHz	250
7.68MHz	200
8.0MHz	150
8.08333M	395
8.86723M	175
9.00MHz	150
10.0MHz	175
10.24MHz	200
10.7	150
12.0MHz	175
12.528M	300
14.31814M	170
16.0MHz	200
18.0MHz	180
18.432M	150
20.0MHz	265
19.968MHz	150
24.0MHz	170
24.930MHz	325
26.69M	150
27.648M	170
27.145M	190
38.66667M	175
48.0MHz	170
100.0MHz	295
116.0MHz	250

RELAYS

Miniature, enclosed, PCB mount.
SINGLE POLE Changeover
RL6-91 205 Ω Coil; 12V DC (10V5 to 19.5 V). 10 A at 30 V DC or 250 V AC **185p**
DOUBLE POLE Changeover. 6 A 30 V DC or 250 V AC
RL6-100 53 Ω Coil, 6 V DC (5V4 to 9V9) **190p**
RL6-111 205 Ω Coil, 12 V DC (10V7 to 19V5) **195p**
RL6-114 740 Ω Coil, 24 V DC (22V to 37 V) **200p**

ASTEC UHF MODULATORS
6 MHz Standard 375p
8 MHz Wideband **550p**

BUZZERS, miniature, solid state 6V; 9V & 12V **70p**

PIEZO TRANSDUCERS
PB2720 **60p**

LOUDSPEAKERS
Miniature, 0.3W: 8Ω
2in, 3¼in, 2½in, 3in **80p**
2½in, 40Ω, 64Ω or 80Ω **80p**

MONITORS

- Zenith — 12" Green or amber, Hi-Resolution Popular £68
- MICROVITEC 1431, 14" Colour RGB input. Connecting Cable incl. £165
- KAGA 12". Med-Res. RGB. Colour. Has flicker-free characters. Ideal for BBC, Apple, VIC, etc. **£195** (car.7)
- KAGA 12". As above but Hi-Resolution **£259** (car.7)
- Connecting Lead for KAGA £5
- Carriage £7 securicor.

BBC MICRO WORD-PROCESSING PACKAGE

A complete wordprocessing package consisting of BBC Micro, Zenith Green Hi-res Monitor, twin cased 200K Disc Drives, Wordwise, Watford's DFS interface, Brother HR15 Daisywheel printer, Database package, 10 Discs, all manuals and cables.
All you require is a mains power point to have it up and running.

Only: £1145

TRANSFORMERS
3-0-3V; 6-0-6V; 9-0-9V; 12-0-12V; 15-0-15V 100 mA **98p**
pcb mounting. Miniature, Split Bobbin
3VA: 2 × 6V-0.25A; 2 × 9V-0.15A; 2 × 12V-0.12A; 2 × 15V-0.1A **235p**
6VA: 2 × 6V-0.5A; 2 × 9V-0.3A; 2 × 12V-0.25A; 2 × 15V-0.2A **280p**
Standard Split Bobbin type:
6VA: 2 × 6V-0.5A; 2 × 9V-0.4A; 2 × 12V-0.3A; 2 × 15V-0.25A **250p**
12VA: 2 × 4.5V-1.3A; 2 × 6V-1A; 2 × 9V-0.6A; 2 × 12V-0.5A; 2 × 15V-0.4A; 2 × 20V-0.3A **345p** (35p p&p)
24VA: 2 × 6V-1.5A; 2 × 9V-1.2A; 2 × 12V-1A; 2 × 15V-0.8A; 2 × 20V-0.6A **385p** (60p p&p)
50VA: 2 × 6V-4A; 2 × 9V-2.5A; 2 × 12V-2A; 2 × 15V-1.5A; 2 × 20V-1.2A; 2 × 25V-1A; 2 × 30V-0.8A **480p** (60p p&p)
Specially wound for Multirail Computer PSUs
50VA: Outputs +5V/5A; +12V, +25V, −5V, −12V at 1A **575p** (60p p&p)
100VA: 2 × 12V-4A; 2 × 15V-3A; 2 × 20V-2.5A; 2 × 25V-2A; 2 × 30V-1.5A; 2 × 50V-1A
920p p&p charge to be added over and above our normal postal charge).

VOLTAGE REGULATORS

1A	TO220 type		Plastic ve	Casting
5V	7805	50p	7905	50p
12V	7812	45p	7908	60p
15V	7815	45p	7912	50p
18V	7818	45p	7915	50p
24V	7824	45p	7918	50p
			7924	50p
100mA	TO92	Plastic		package
5V	78LO5	30p	79LO5	50p
6V	79LO6	30p		
8V	79LO8	30p		
12V	78L12	30p	79L12	50p
15V	78L15	30p	79L15	50p

ICL7660	248p	TAA550	50p
LM309K	135p	TDA1412	150p
LM317K	250p	78HO5 + 5V/5A	560p
LM317KP	99p	78H12 + 12V/5A	640p
LM323K	450p	78HG + 5V to +25V	
LM337	175p	5 A	585p
LM723 Var	30p	78S40	225
RC4194	375p	79HG 2.25V to	
RC4195	160p	24V 5A	685p

SOLDERCON PINS
Ideal for making SIL or DIL Sockets

100 pins	45p
500 pins	195p

ALUM BOXES

3 × 2 × 1"	65p
4 × 2½ × 2"	85p
4 × 2¾ × 2½"	103p
4 × 4 × 2"	105p
4 × 4 × 2½"	120p
5 × 4 × 1½"	99p
5 × 4 × 2½"	120p
5 × 2¾ × 1½"	90p
5 × 2¾ × 2½"	130p
6 × 4 × 2"	120p
6 × 4 × 3"	150p
7 × 5 × 3"	180p
8 × 6 × 3"	210p
10 × 4 × 3"	240p
10 × 7 × 3"	275p
12 × 5 × 3"	260p
12 × 8 × 3"	295p

'D' CONNECTORS miniature

	9 way	15 way	25 way	37 way
MALE				
Solder lugs	80p	105p	160p	250p
Angle pins	150p	210p	250p	365p
PCB pins	120p	130p	195p	295p
FEMALE				
Solder lugs	105p	160p	200p	335p
Angle pins	165p	215p	290p	440p
PCB pins	150p	180p	240p	420p
COVERS	85p	80p	80p	100p
IDC 25way 'D' Plug				385p
Socket				450p

25way 'D' CONNECTOR RS232
Jumper Lead Cable Assembly

18" long, Single end, Male	495p
18" long, Single end, Female	525p
36" long, Double Ended, M/M	1025p
36" long, Double Ended, F/F	1050p
36" long, Double Ended, M/F	995p

CMOS

4000	20
4001	25
4002	25
4006	75
4007	25
4008	60
4009	45
4010	60
4011	25
4012	25
4013	60
4014	60
4015	60
4016	40
4017	60
4018	60
4019	58
4020	90
4021	58
4022	
4023	30
4024	50
4025	22
4026	90
4027	43
4028	45
4029	75
4030	35
4031	130
4032	70
4033	130
4034	140
4035	70
4036	275
4037	115
4038	110
4039	250
4040	60
4041	57
4042	50
4043	42
4044	50
4045	110
4046	60
4047	60
4048	55
4049	38
050	35
051	70
052	60
053	60
054	85
055	85
056	85
057	£10
059	435
060	68
061	500
062	995
063	86
066	45
067	245
068	25
4069	25
4070	25
4071	25
4072	25
4073	26
4075	25
4076	68
4077	25
4078	25
4081	25
4082	25
4085	60
4086	80
4089	125
4093	37
4094	70
4095	95
4096	100
4097	290
4098	80
4099	110
4160	95
4161	99
4162	99
4163	99
4174	99
4175	105
4194	105
4408	850
4409	850
4410	725
4411	750
4412	805
4415	590
4419	280
4422	770
4435	860
4440	999
4450	350
4451	350
4490	450
4500	675
4501	38
4502	60
4503	40
4504	99
4505	385
4506	100
4507	45
4508	130
4510	55
4511	55
4512	55
4513	150
4514	115
4515	115
4516	55
4517	275
4518	48
4519	32
4520	53
4521	115
4522	125
4526	70
4527	85
4528	68
4529	150
4530	90
4531	130
4532	65
4534	400
4536	275
4538	80
4539	90
4541	95
4543	70
4544	150
4548	40
4549	400
4553	246
4554	190
4555	36
4556	55
4557	250
4558	120
4559	396
4560	160
4561	104
4562	350
4566	165
4568	250
4569	175
4572	45
4580	255
4581	125
4582	99
4583	100
4584	60
4585	60
4597	330
4599	155
40085	90
40097	45
40098	42
40100	215
40101	130
40102	140
40103	412
40104	120
40105	220
40106	60
40107	55
40108	325
40109	80
40110	235
40114	240
40161	194
40163	75
40174	75
40175	75
40181	220
40182	90
40192	75
40193	70
40194	70
40195	75
40244	196
40245	196
40257	196
40373	220
40374	220
45106	596

OPTO ELECTRONICS

LEDs with Clips

TL209 Red	10
TIL211 Grn	14
TIL212 Yel.	14
TIL220 .2" Red	12
.2" Green, Yellow or Amber	14
0.2" Bi colour	
Red/Green	100p
Green/Yellow	115p
0.2" Tri colour	
Red/Green/Yellow	85
Hi-Brightness Red	59
Hi-Bri Green or Yellow	68
Flashing red 0.2" red	55
Square LEDs, Red, Green, Yellow	45
Rectangle Stackable LEDs	
Red, Green or Yell	18
Triangular LEDs	
Red	18
Green or yellow	22
LD271 Infra Red	46
SFH205 Detector	118
TIL32 Infra Red	52
TIL78 Detector	55
TIL38	50
TIL100	75
BARGRAPH, Red 10 segments	275

7 Segment Displays

TIL312 .3" CA	120
TIL313 .3" CC	120
TIL321 .5" CA	140
TIL322 .5" CC	140
TIL729/730	140
DL704 .3" CC	125
DL707 .3" CA	125
FND357 Red	120
FND500	130
.3" Green CA	150
.6" Green CA	215
.3" ± 1 Red CA	150
.3" ± 1 Green CA	150
LCD 3½ Digits	**495**
LCD 4 Digits	**530**
LCD 6 Digits	**625**

NEONS
Rectangular, nut fixing Red, Amber, Green 30p
REFLECTIVE Optical Switch type TIL139 225p
SLOTTED Optical Switch similar to RS Comp.'s 295p

ISOLATORS

IL74	145
ILD74	145
ILQ74	275
TIL111/2/4	70
TIL117	125
4N33 Photo Darlington	135

OPTO

LS400C	255
OCP71	120
ORP12	86
ORP61	85
2N5777	45
BPX25	195
BPW21	295

AMPHENOL CONNECTORS

PLUGS (Male)	IDC	Solder
24 way IEEE	475p	470p
36 way Centronix	525p	475p
24 way Female	490p	450p

COMPUTER CORNER

- EPSON RX80 Printer £229
- EPSON RX80 F/T Printer £245
- EPSON FX80 Printer £316
- EPSON FX100 Printer £435
- KAGA/TAXAN KP810 Printer £246
- KAGA/TAXAN KP910 Printer £346
- SEIKOSHA GP100A Printer £125
- BROTHER HR15 Daisywheel £339
- Cable for above printers to interface with BBC Micro £7
- TEX EPROM ERASER — Erases upto 25 Eproms. Has a built-in safety switch. £30
- SPARE 'UV' lamp bulb £8
- C12 Computer CASSETTES in Library cases 36p
- 8½" & 9½" Fan Fold Paper (1000 Sheets)..... £7 (Carr. 150p)

(Securicor Carriage charge on printers is £7)

CUMANA DISK DRIVES (TEC)
(BBC Compatible)

- CS100 — Single Cased with PSU, 40 track, 5¼" S/S 100K £125
- CD200 — Twin Cased with PSU, 40 track, 5¼" S/S 200K £236
- CS200 — Single Cased with PSU, 80 track, 5¼" S/S 200K £149
- CD400 — Twin Cased with PSU, 80 track, 5¼" S/S 400K £299
- MITSUBISHI Single Slimline 5¼" Cased with PSU. DSDD, 1 Megabyte. (400 K with BBC)......................... £169
- MITSUBISHI Twin Slimline, 5¼" Cased with PSU, DSDD, 2 Megabyte, (800 K with BBC)......................... £349

5¼" DISKETTES (Lifetime Warranty)

- 10 3M Diskettes Single side Double Density.............. £13
- 10 3M Diskettes Double side Double Density £23

N.B. Carriage on Drives £7 Securicor

SPECTRUM 32K RAM UPGRADE KIT

Upgrade your 16K SPECTRUM to 48K. Full fitting instructions supplied.

ONLY: £22

SPECTRUM CENTRONICS/RS232 PRINTER INTERFACE

- It was the first! It is still the best!
- Centronics and BI-DIRECTIONAL RS-232 with full handshaking.
- Obeys SPECTRUM LLIST and PRINT
- Split-Speed Operation for RS-232.

(Use it to communicate with the BBC MICRO or OTHER PERIPHERALS)

- Interface 1, Interface 2 & Microdrive compatible.
- Configuration program creates customized M/C driver to suit your printer.
- HI-RES screen dumps in 2 sizes on EPSON, SEIKOSHA, STAR, SHINWA, MANNESMAN TALLY, NEC, RITEMAN, KAGA, etc. This is a STANDARD FEATURE! Not an extra.
- Compatible with TASWORD TWO and most professional programs.

Only: £29.95

Centronics Parallel Printer Cable £8

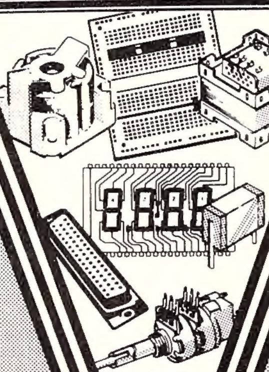
BBC MICROCOMPUTER & ACCESSORIES

BBC Micro Model B ...... only £315

We stock the full range of BBC Micro peripherals, Hardware & Software like, Disc Drivers (Top quality Cumana & Mitsubishi), Diskettes, Printers, printer Paper, Interface Cable, Dust Covers, Cassette Recorder & Cassettes, Monitors, Connectors, (Ready made Cables, Plugs & Sockets), Plotter (Graphic Tablet) EPROM Programmer, Lightpen Kit, Joysticks, Sideways ROM Board, EPROM Eraser, Machinecode ROM, The highly sophisticated Watford's 16K BEEB DFS, WORDWISE, BEEBCALC, Software (Eductional Application & Games), BOOKs, etc, etc,. Please send SAE for our descriptive leaflet.

FOR QUALITY COMPONENTS BY MAIL ORDER

ELECTROVALUE



FREE
44 PAGE
PRICED AND
ILLUSTRATED
CATALOGUE
ON REQUEST

FREE POSTAGE
GOOD DISCOUNTS
GOOD SERVICE
THOUSANDS OF
STOCK ITEMS
PHONE YOUR ORDER
ACCESS OR
BARCLAYCARD

ELECTROVALUE LTD 28 St. Jude's Road, Englefield Green, Egham,
Surrey TW20 0HB Phone Egham (0784) 33603. Telex 264475
North Branch, 680 Burnage Lane, Manchester M19 1NA
Phone 061 432 4945
Please mention this publication when replying

The prices quoted in my Catalogue are below normal trade price — some at only one tenth of manufacturers quantity trade. Just send large 24p stamped addressed envelope for free copy.

Millions of components: thousands of different lines

Rechargeable Nickel Cadmium batteries (ex unused equipment) AA(HP7) 1.25 volt 500 mA. Set of four £2
I.T.T. Mercury Wetted relay 20-60 VDC Coil. SPCo. 2 A. 79p or 10 for £7
Clear L.E.D. illuminates Red, Green or Yellow depending upon polarity/current.
Oblong 5 × 2½ mm Face 25p or 100 for £23 or 1000 for £200
5 mm Red Flashing L.E.D. 25p or 10 for £2.25
Watch/Calculator/Lighter etc. Mercury Batteries
RW52 (PX675) RW54 Made by Ray-O-VAC
RW56 (DH323, WH8) 30p each or
RW57, RW58 20 got £2.60, 100 for £21
IN4004 or IN4006 Diodes 300 for £6.50
TO5 or TO28 Heatsinks 7½p. 100 for £6.50, 1000 for £55
Clipover Heatsink for I/C or TO202 device 21 × 18 mm 18 or 100 for £16.50 or 1000 for £155
Heatsink for TO3 or Plastic Power 19p. 10/£17.50, 1000/£165
KBS005/01/02 3 amp 50 V/100 V/200 V/bridge rectifiers 35p/36p/40p. 10 off £3.20/£3.40/£3.70. 100 off £30/£31/£34.
Plessey SL403 3 Watt amp. From Bankrupt source, hence sold as untested. 4 for 60p or 10 for £1.20p.

SEND PAYMENT PLUS 17p SAE OR LABEL

Postal orders/cash — prompt dispatch.
Cheques require 9 days from a Tuesday banking to clear.
Crossed postal orders and cheques — add 20p handling due to Bank's increasing 'commission' on business accounts.
Cheques drawn on Barclay's Bank not accepted.

Prices you would not believe before inflation!

BRAIN J. REED

TRADE COMPONENTS
ESTABLISHED 27 YEARS

161 St. Johns Hill, Clapham Junction, London SW11 1TQ.
Open 11 am till 6.30 pm Tues. to Sat. Telephone 01-223 5016

SKYBRIDGE

Mail order & shop:
441 PRINCES ROAD,
DARTFORD, KENT DA1 1RB Telephone: (0322) 91454

ORDERING INFORMATION: P/P 50p on orders less than £20 in value otherwise post free. All components full spec & guaranteed. Discounts available on orders over £50 – phone for details. For unlisted components phone for price.

CABLE Per metre

wire wrap	6p
Red/white/black solid	1/.6
11 colours	4p
Hook-up	7/.2
11 colours	3p
Heavy duty	32/.2
4 colours	15p
Extraflex red/black	15p
Tinned copper per 40z reel	
SWG16	80p
SWG18	85p
SWG20	95p
SWG22	95p
SWG24	95p
En copper per 20z reel SWG14	70p
SWG16	80p
SWG18	90p
SWG20	90p
SWG22	90p
SWG24	105p
SWG26	105p
SWG28	105p
SWG30	110p
SWG33	110p
SWG34	115p
SWG36	125p
SWG38	125p
SWG40	150p
Figure 8 per metre 7/.25	13p
Coloured ribbon per foot	
10 way	20p
20 way	40p
34 way	80p
Mains per metre 2 core Oval 3A	20p
Round 6A	45p
3 core Round 3A	35p
Round 6A	50p
Round 13A	80p

Power

1 mm T&E	40p
1.5 mm T&E	45p
2.5 mm T&E	60p
6 mm T&E	150p
TV COAX	40p
Screened Single round	17p
Twin round	20p
Figure 8 min	20p
Figure 8 std	30p
4 Core	70p
Spiral wrap	
1/8"	15p
¼"	20p
½"	45p

Wide range of cable markers, sleeving, ties, fixings in stock-Phone for details.

CAPACITORS

Plate ceramic	
1.8pF – 22nF	8p
Disc	
10pF	10p
47pF	15p
100pF	15p
470pF	15p
1000pF	11p
2200pF	11p
.01µF	5p
.022µF	5p
.047µF	8p
.1µF	8p
.47µF	15p
Polystyrene	
22pF	13p
47pF	8p
68pF	8p
100pF	8p
150pF	8p
220pF	8p
330pF	8p
470pF	8p
560pF	8p
680pF	8p
1000pF	8p
1500pF	8p
2200pF	8p
3300pF	8p
4700pF	8p
5600pF	10p
6800pF	10p
.01µF	14p
.022µF	19p
.047µF	25p
.1µF	49p
Polyester	
.01µF	8p
.015µF	8p
.022µF	8p
.033µF	9p
.047µF	9p
.068µF	9p
.1µF	9p
.15µF	15p
.22µF	11p
.33µF	16p
.47µF	16p
.68µF	26p
1µF	26p
2µF	49p
Electrolytic	
µF/V 1/63	8p
2.2/50	9p
4.7/63	9p
10/16	8p
10/25	8p
10/35	10p
10/63	13p
22/10	8p
22/16	10p
22/25	10p
22/35	11p
22/63	15p
47/10	10p
47/16	11p
47/25	13p
47/35	15p
47/63	24p
100/10	11p
100/16	13p
100/25	15p
100/35	19p
100/63	25p
220/16	15p
220/25	20p
220/35	23p
220/63	33p
470/16	23p
470/25	27p
470/35	31p
470/63	48p
1000/10	24p
1000/16	29p
1000/25	41p
1000/35	45p
1000/63	75p
2200/10	39p
2200/16	46p
2200/25	55p
2200/35	74p
3300/25	74p
3300/35	92p
4700/10	59p
4700/16	74p
4700/25	103p
Non-polarised	
1µF	25p
2.2µF	25p
3.3µF	25p
4.7µF	25p
6.8µF	50p
10µF	25p
22µF	35p
33µF	40p
47µF	40p
100µF	70p

Thousands of other capacitors in stock i.e. Silvered Mica, 1% Polystyrene, Polycarbonate, Mylar, Tantalum, Trimmer, Variable etc. etc.

CRYSTALS

100k	460p
1M	600p
2M	220p
3.2768M	poa
4M	180p
4.19304M	320p
4.433619M	320p
6.144M	130p
10M	200p
18.432M	270p
26.54M	200p
26.59M	200p
26.64M	200p
26.69M	200p
26.74M	200p
26.79M	200p
26.8M	200p
26.995M	200p
27.045M	200p
27.095M	200p
27.145M	200p
27.195M	200p
27.245M	200p
27.255M	200p

CONNECTORS

Croc clips	10p
Terminal post	40p
1mm plug	20p
1mm socket	15p
2mm plug	20p
2mm socket	15p
3mm plug	20p
3mm socket	15p
4mm plug	15p
4mm socket	15p
Phono plug	10p
Phono line skt	20p
Jack plug 2.5mm	15p
Jack plug 3.5mm	15p
Jack skt 2.5mm	15p
Jack skt 3.5mm	15p
Jack skt line 2.5mm	30p
Jack skt line 3.5mm	25p
Jack plug ¼" mono	20p
Jack plug ¼" stereo	30p
Jack skt ¼" mono	25p
Jack skt ¼" stereo	35p
Jack skt line mono	25p
Jack skt line stereo	30p
COAX plug	15p
COAX skt surf	30p
COAX skt flush	25p
COAX line skt	45p
COAX coupler	45p
CAR aerial plug	15p
FM aerial plug	20p
BNC plug	100p
BNC round skt	100p
BNC square skt	100p
BNC free skt	110p
BNC str. adapt.	140p
BNC T adapt.	300p
VHF plug PL259	50p
Small reducer	20p
Large reducer	20p
PL259 rt.ang.	90p
VHF round skt.	50p
VHFsquare skt	50p
Ebow adapt.	poa
Straight adapt.	60p
VHF T adapt.	160p
Female T adapt.	180p
XLR line plug	180p
XLR chassis skt	330p
XLR line skt	230p
XLR chassis plug	160p
DIN plugs 2 pin	10p
DIN plugs 3 pin	15p
DIN plugs 4 pin	35p
DIN plugs 5 pin A	15p
DIN plug 5 pin 240°	20p
DIN plug 5 pin 360°	30p
DIN plug 6 pin	40p
DIN plug 7 pin	20p
DIN plug 8 pin	60p
DIN skts 2 pin	10p
DIN skts 3 pin	20p
DIN skts 4 pin	15p
DIN skts 5 pin A	15p
DIN skts 5 pin B	20p
DIN skts 6 pin	20p
DIN skts 7 pin	20p
DIN line skt 2 pin	15p
DIN line skt 5 pin	30p
D-type plug 9 W	80p
D-type plug 15 W	150p
D-type plug 25 W	150p
D-type skt 9 W	140p
D-type skt 15 W	200p
D-type skt 25 W	450p
D-type rt ang. skt 9 W	poa
D-type rt ang. skt 15 W	poa
D-type rt ang. skt 25 W	poa
D-type rt ang. plug 9 W	poa
D-type rt ang. plug 15 W	poa
D-type rt ang. plug 25 W	poa
Covers 9	120p
Covers 15	120p
Covers 25	130p
Latches 9	30p
Latches 15	50p
Latches 25	60p
Power plug 2.1mm	15p
Power plug 2.5mm	15p
IEC line skt	95p
IEC chassis plug	90p
IEC chassis skt	90p
IEC line plug	70p
Bulgin P429	50p
Bulgin P646	165p
Bulgin P430	125p
Bulgin P649	135p
Bulgin P650	110p
Bulgin P635	100p
Bulgin P636	130p
Bulgin P551	300p
Bulgin P552	100p
Bulgin SA2403	160p
Bulgin SA2404	95p
Bulgin SA2190	50p
Bulgin SA1862	50p
Bulgin SA2111	200p
Bulgin SA2019A	150p
Bulgin SA2020	140p
Bulgin SA2367	180p
Bulgin SA2368	95p

Many other connectors, adapters & leads in stock.

OPTO

LED Std red	10p
LED Std green	18p
LED Std yellow	15p
LED Min red	10p
LED Min green	18p
LED Min yellow	18p
LED clip std	3p
LED clip min	3p

Large range of panel lampholders, de luxe LEDs, etc.

FUSEWARE

20mm panel holder	45p
1¼" panel holder	59p
20mm chassis holder	14p
1¼" chassis holder	17p
Line holder	14p
Fuse clips	3p
20mm fuses 100mA, 150mA, 250mA, 500mA, 1A, 1.5A, 2A, 3A, 5A	9p
20mm antisurge fuses 500mA, 1A, 2A	12p
1¼" fuses 100mA, 150mA, 250mA, 500mA, 1A, 2A, 3A, 5A, 10A, 13A, 15A	9p
1" fuses 2A, 3A, 5A, 13A	15p

RESISTORS

⅓ W 5% E24	2p
.4W 1% E24	7p
1W 5% E12	10p
3W ww L22-1R	30p
3W ww 2R2	20p
7W ww	30p
10W ww	35p
25W ww	170p
Ww Pots. 3W High quality	275p

10R, 25R, 50R, 100R, 250R, 500R, 1k, 5k, 10k, 50k.

SEMICONDUCTORS

So extensive is the range of listed semiconductors Please send large S.A.E. for details.

Transistor mounts	
TO3	10p
TO66	10p
DIL sockets 8 pin	9p
14 pin	11p
16 pin	12p
18 pin	16p
20 pin	17p
22 pin	20p
24 pin	21p
28 pin	24p
40 pin	35p

Range of heat sinks available – Phone for quotation.

SPEAKERS

Miniature buzzer 6V or 12V	90p
Ultrasonic transducers pair	600p
Elliptical 5"x3"	198p
Elliptical 6"x4"	262p
Elliptical 7"x4"	314p
Elliptical 7"x5"	338p
Elliptical 8"x5" 5W	386p
Elliptical 8"x5" 8W	521p
Elliptical 9"x6"	431p
Miniature 1"	90p
Miniature 1½	90p
Miniature 1¾	90p
Miniature 2"	90p
Miniature 2¼	90p
Miniature 2½" 8R	90p
Miniature 2½" 64R	100p
Round 5" 4W	174p
Round 5" 25W	409p
Round 5" 60W	1587p
Round 5¼" 10W	476p
Round 5½" 15W	771p
Round 6" 5W	297p
Round 6" 60W	1632p
Round 6½" 7W	423p
Round 8" 6W	359p
Round 8" 10W	423p
Round 8" 20W	963p
Round 8" 60W	1346p
Round 10" 10W	700p
Round 10" 20W	1113p
Round 10" 30W	poa
Round 12" 60W	2862p
Round 12" 100W	4073p
Round 12" 150W	4336p
Round 15" 150W	7185p
Round 15" 200W	8735p
Round 18" 200W	£108
Motorola piezo tweeters 2"	231p
3½"	697p
2"x6" horn	938p
2"x5" horn	795p
2½" horn	457p
3¾"	624p
4"x10"	1435p
Crossovers	
2 way 15W	188p
2 way 100W	690p
3 way 25W	193p
3 way 40W	338p
3 way 60W	502p
3 way 100W	1346p
4 way 80W	628p

SWITCHES

Toggle Std SPST	47p
Toggle Std DPDT	62p
Toggle Min SPST	68p
Toggle Min SPDT	70p
Toggle Min SPDT c/off	83p
Toggle Min DPDT	85p
Toggle Min DPDT c/off	117p
Toggle Min 4PDT	209p
Toggle Min 4PDT c/off	244p
Push to make	20p
Push to break	20p
Key sw spst	259p
Rotary 1P 12W	62p
Rotary 2P 6W	62p
Rotary 3P 4W	62p
Rotary 4P 3W	62p
Sude min DPDT	22p
Sude std DPDT	22p
DIP 4W	105p
DIP 6W	128p
DIP 8W	156p
DIP 10W	184p
Microswitch	83p

TRANSFORMERS

6-0-6 V, 100mA	167p
6-0-6 V, 250mA	185p
9-0-9 V, 100mA	167p
9-0-9 V, 250mA	185p
12-0-12 V, 50mA	155p
12-0-12 V, 100mA	171p
12-0-12 V, 250mA	188p
0-12/0-12 V, 500mA	369p
9-0-9 V, 1A	283p
12-0-12 V, 1A	350p
15-0-15 V, 1A	433p
20-0-20 V, 1.5A	538p
0-12-15-20-24-30 V 1A	666p
6-0-6 V, 2A	440p
9-0-9 V, 2A	476p
12-0-12 V, 2A	538p
0-12/0-12 V, 2A	538p
0-12-15-20-24-30 V 2A	900p
20-0-20 V, 2A	745p
30-0-30 V, 2A	933p
12-0-12 V, 3A	721p
0-15 V, 3A	647p
6-0-6 V, 4A	538p
9-0-9 V, 4A	687p
12-0-12 V, 4A	845p
0-15 V, 6A	949p
6-0-6 V, 8A	980p
12-0-12 V, 8A	1615p
Toroids: 30VA 6V	950p
30VA 9V	950p
30VA 12V	950p
30VA 15V	950p
30VA 18V	950p
50VA 6V	1150p
50VA 9V	1150p
50VA 12V	1150p
50VA 15V	1150p
80VA 18V	1200p
80VA 22V	1200p
80VA 30V	1200p
120VA 30V	1300p
160VA 35V	1500p
300VA 35V	2000p
500VA 35V	2650p

All toroids have two isolated secondaries at voltages shown.

CHILTERN ELECTRONICS

☆ SURPLUS EQUIPMENT SALE ☆

VIDEO MONITORS – NEW SURPLUS

Brand new professional quality hi-resolution AGC green screen monitors in attractive metal case.

Composite video. Ideal for BBC or other micros.

High definition makes easy viewing for 80 column text.

Bandwidth 10Mhz to 22Mhz.

ONLY £44

USUAL PRICE
£85/£89

SALE PRICE	9" HM911	**£44**
	12" HM123	**£46**

Add VAT and £5 carriage

VDU BARGAIN

The world-famous ADDS terminals offered at a fraction of original cost!

*RS232 up to 9600 baud
*80 col x24 line display
*Video + printer outputs

Used condition but fully tested.

Only **£79** + VAT
Carriage £12.50

MAINS FILTER UNITS

(BRAND NEW SURPLUS)

These compact units consist of heavy duty 12amp filter and circuit breaker, and IEC socket. Ex-mainframe system, ideal for protecting TV/Micro etc.

(Cost £60+!) Our price **£4** + VAT
p/p £1

or 3 for **£10** post free

INTERFACE CARDS

FOR *APPLE II & II E. BRAND NEW BY VARIOUS MANUFACTURERS

Save **50%** or more ! !

- Printer Card
- 80 Column Card
- PAL Colour Card
- RS232 Card
- Clock Card
- Communications Card
- Forth Card

All at ONLY **£22** each + VAT post free

*Trademark of Apple Computer Inc.

ASC II KEYBOARDS

Scoop purchase allows us to offer a real professional keyboard (49-key ASCII), with Hall-effect keys and attractive case for a ridiculous price.

Circuits supplied. Used tested.

Original cost £300 +.

Only **£18** + VAT
Carriage £1.85

PRESTEL TERMINALS

Brand new STC desk top terminals – ready to plug into your telephone for Prestel service.

These beautifully made units have a 6" green-screen monitor and originally cost over £500 each.

Our Price NEW only **£99**
Add VAT and £7 carriage

DAISY-WHEEL PRINTERS

Brand new surplus TPI letter quality printers — ideal for your micro.

Made by Smith-Corona – offered at way under usual cost.

Centronics or RS232 interface.

Only **£149**
Add VAT and £10 Carriage

MICRO-POWER SUPPLIES

We have a large range of surplus power supplies from 1 amp to 120 amps. Please send for list.
All at a fraction of list price! !

Examples:

Advance 0–7v 3a	**£10**
Lambda 5v 5a s/mode new	**£20**

Add VAT + £5 p/p

FLOPPY DISKS

8" inch and 5¼" standard Shugart interface drives.

New condition ex-equipment.

£79 + VAT
Carriage £6

Box of 10 BRAND NEW BASF S/S S/D 5" diskettes . . .

£9.50 + VAT
p/p £1

CENTRONICS PRINTERS

These famous printers need no introduction. As used by most large mainframe computers.

Model 306 (Used)	**£149**	Model 701	**£179**

Add VAT and £15 carriage

MINI-COMPUTER FANS

Brand new 230v 5" whisper quiet. Offered at ¼ list price.

£4.60
Add VAT and £1 postage

COMPUTER STATIONERY

132 column printout paper at quarter list price! Box of 2000 sheets

Only **£4.99** + VAT
Add £3 carriage

We have hundreds more special offers which must be sold by February – phone or send for our list.

HURRY – **OFFERS ONLY VALID WHILE STOCKS LAST!**

WE ARE EUROPE'S LEADING SUPPLIER OF SECOND-HAND MAINFRAME COMPUTER SYSTEMS. ALL THE ABOVE EQUIPMENT IS GENUINE PROFESSIONAL EQUIPMENT SURPLUS TO OUR REQUIREMENTS.

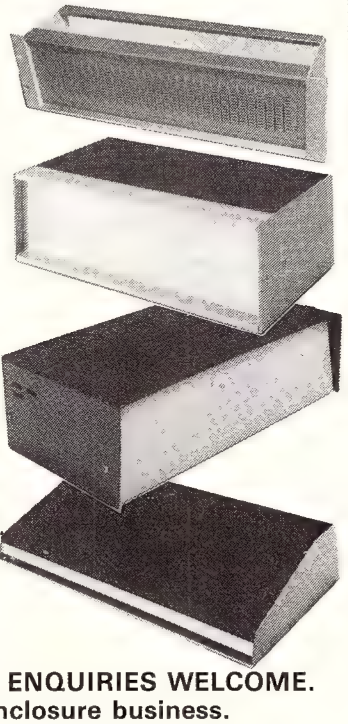
HIGH STREET, CHALFONT ST. GILES, BUCKINGHAMSHIRE HP8 4QH TEL. 02407 71234
Telephone or send your order to TIM READING. We accept personal cheques or telephone your Access Card No.
All items despatched within 24 hours

Newrad

UNIT 19 · WICK INDUSTRIAL
ESTATE · GORE ROAD · NEW
MILTON · HANTS · BH25 6SJ
Telephone: NEW MILTON
615774/621195

INSTRUMENT CASES LTD.

We manufacture beautiful enclosures. Ask for catalogue (which includes £5 in vouchers). You won't believe the prices.



19" Rack mounted, Free Standing and Plug-in Module frames using high quality extrusions.
Prices from . . . . **£15.00** + VAT

High quality Pack-flat enclosures with separate Chassis.
Prices from . . . . . **£9.60** + VAT

2 Part enclosures plus Chassis. Hammer Blue finish.
Prices from . . . . . **£3.04** + VAT

Keyboard and Console Units.
Prices from **£4.90**

TRADE AND EXPORT ENQUIRIES WELCOME.
over 12 years in the enclosure business.

RVM Audiotronic

Abbots Hill Chambers
1st Floor, Gower Street,
Derby DE1 1SD

Tel: Derby 0332/382433

Modules	Power RMS	Load	Volt Max	Size (mm)	Price
RVM150S	70-150W	4, 8,	±60	31x80x100	1+**23.50** 10+**19.98** 20+**19.80**
RVM300S	120-300W	4-8,	±65	31x102x136	1+**32.87** 10+**27.94** 20+**26.30**
RVM400S	170-400W	4-8,	±65	47x89x136	**40.92**
RVM700S	300-700W	2-8,	±70	47x90x197	**60.96**
RVM700S Mounted on Heat Sink					**70.40**

KIT PRICE

RVM150S	1+**19.50**	10+**15.98**	20+**15.80**
RVM300S	1+**28.87**	10+**23.94**	10+**22.30**

MAIL ORDER ONLY

RVM RANGE OF POWER MOSFET AMPLIFIER MODULES.
These Power Mosfet Modules are very reliable, driving difficult loads is no problem. Application from hi power systems to studio to domestic hi-fi.
All of our modules are built and tested and carry a 2 year guarantee.
We also supply a range of heat sinks, specially recommended for RVM modules.

All prices include post & packing.
(Quantity discount available)

To order send cash with order, or cheque/postal order.

Delivery on our Modules and Heat Sink or same day dispatch when order is received with cash, allow 7 days with cheque or postal order.

LOOK — IT'S HIS NEW YEAR SPECIAL!

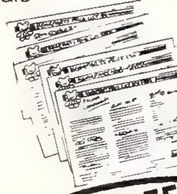
We are the main stockists for **'BEARPARTS'**, the new name in electrical, electronic and audio components.

Interested?
Send S.A.E. and receive your FREE **'BEARPARTS'** sample pack.

BEARPARTS

CONTENTS OF PACK: BC 612 Transistor, Red LED, 1N4004 Diode, 1I646 Diode, 560pf 200v Capacitor, 1nf Ceramic Disk Capacitor, 10k, 150k Resistors, 2k Multiturn Potentiometer, 4BA Crimp Eyelet, Rubber Grommet, Instrument Wire, Sleeving.

6 BEARPARTS PRICE CARDS JUST PHONE!



10% OFF Bearparts Components & Kits until Jan. 31st.

TREAT YOURSELF THIS XMAS!

COMPLETE SOLDERING KIT
(For the Hobbyist/Electronics Engineer)

LIMITED OFFER WHILE STOCKS LAST!

FOR LESS THAN £10!!

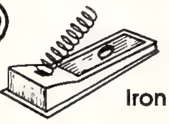
Comprises of:-

- Antex Miniature 15W 240v AC Soldering Iron
- Antex Iron Stand c/w Sponge
- Desolder Pump
- 2 mtr Solder
- Desolder Braid
- 13A Plug

ONLY **£9.85** Please add 80p P & P + 15% VAT.

Desolder Pump

Soldering Iron



Iron Stand c/w Sponge

AIR FRESHENER KIT
ONLY £8.95

- For office & home
- 240 AC Operation
- Includes Airfresh Gel
- Complete with case

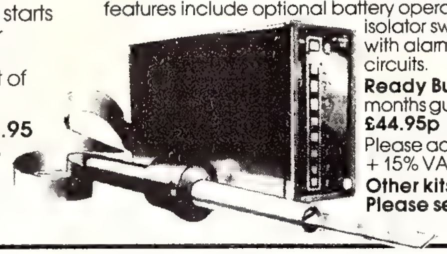
The unique on/off timer controlled circuit starts the fan at regular intervals giving a controlled output of fragrance.

Ready Built - £11.95
Please add £1.45 P & P+15% V.A.T.

PROFESSIONAL LEVEL INDICATOR KIT
ONLY £39.30p

- 240 AC Operation
- British Standards DIN Case
- LED Display
- Quality P.C.B. & Components
- Complete with P.M. Level Probe

When probe is immersed in a liquid its depth is indicated on the units LED display. Additional circuit features include optional battery operation & octo-isolator switching for use with alarm or logic circuits.



Ready Built with 12 months guarantee - **£44.95p**
Please add £1.45 P & P + 15% VAT.
Other kits available. Please send for details.

Call in and see our new counter now open
9.00 - 5.00 Mon-Fri
9.00 - 12.00 Sat
Too far to call? Don't worry, export/mail order is our speciality. Why not write and find out more.

BARCLAYCARD VISA

SYSTEMS ELECTRONIQUE
(U.K.) LTD.

26 Engineer Park, Sandycroft,
Deeside, Clwyd CH5 2QD.
Tel: (0244) 536700.

QUALITY COMPONENTS FROM CRICKLEWOOD! This list contains only a **FRACTION OF OUR STOCK**, which is constantly being updated. Prices quoted are for "one-offs"-quantity discounts by negotiation. Official orders from Schools, Colleges, Goods Dept etc welcomed. WE SPECIALISE IN CREDIT CARD PHONE ORDERS. A quick call will check stock position and current prices. Add 60p p&p +15% VAT to all orders. All in-stock items despatched same day unless notified.

PRICES SUBJECT TO CHANGE

VISA

FREE CAT.
Please send S A E

CRICKLEWOOD
ELECTRONICS LTD

40 CRICKLEWOOD BROADWAY
LONDON NW2 3ET
01-452 0161/01-450 0995 Tlx:914977

RESISTORS

CARBON FILM 5% HIGH STAB LOW NOISE 10 Ω TO 10 MΩ

¼W E24	2p
½W E24	3p
1W E12	6p
2W E12	12p

METAL FILM ULTRASTABLE 0 4W EXTRA LOW NOISE 10 Ω to 1 MΩ

1% E24	6p

LOW OHMIC GLAZE 0.5W 0 22WU to 8.2Ω

E24	11p

WIRE WOUND ON CERAMIC E12 SERIES

2 to 3W 0.22Ω to 330Ω	28p
4 to 7W 0 47Ω to 6K8	33p
9 to 11W 1Ω to 33K	37p

POTS & PRESETS

ROTARY POTS LOW NOISE ¼" SPINDLES E3 SERIES

4k7 to 2 M LIN	44p
4k7 to 2 M LOG	44p
As above with DP Mains Switch	99p
As above stereo	1.30p

PRE SETS PIHER (DUSTPROOF) E3 100 Ω to 10 MΩ

Mini Vert	16p
Mini Horiz	16p
Standard Vert	19p
Standard Horiz	19p

CERMET 20 TURN PRECISION PRESETS ¼" E3 SERIES

50Ω to 500K	99p

CAPS

CERAMIC 100 V DISC (PLATE) E12 MICRO MINI TYPICALLY ± 5%

1pF to 10nF	7p

POLYCARB 5% SIEMENS 7 5 mm MINIBLOC E12 250 V

1nF to 6n8	7p
8n2 to 47nF	8p
56nF to 150 nF	12p

100 V

100nF to 150nF	13p
180nF to 270nF	16p
330nF to 390nF	25p
470nF to 560nF	32p
680nF	38p
1µF (10mm)	40p

POLYESTER 250V RADIAL (C280)

10nF,15nF, 22nF,33nF, 47nF,68nF, 100nF	7p
150nF,200nF	10p
330nF,470nF	13p
680nF	18p
1µF	22p
1 5µF	39p
2 2µF	39p

FEED THROUGH

1nF 500V	35p

HIGH VOLTAGE Capacitors please enquire many types in stock

TANT BEADS

1 35V	14p
22 35V	14p
33 35V	14p
47/35V	14p
68 35V	14p
1 35V	14p
2 2 35V	14p
3 3 35V	18p
4 7 16V	18p
4 7 35V	20p
6 8 25V	20p
6 8 35V	21p
10 16V	18p
10/35V	27p
15/10V	22p
15 16V	30p
15 25V	32p
22 6 3V	26p
22 16V	41p
33 10V	30p
47 3V	20p
47 6 3V	34p
47 16V	75p
100 3V	32p

ELECTROLYTICS Mainly Panasonic AXIALS (Wires each end)

µFd	V	
47	63	9p
47	100	10p
47	350	35p
1	100	10p
1	500	46p
2 2	25	9p
2 2	63	10p
2 2	100	13p
2 2	350	34p
3 3	40	13p
3 3	63	14p
4 7	35	10p
4 7	50	13p
4 7	63	14p
4 7	100	16p
10	25	9p
10	50	14p
10	63	16p
10	100	18p
10	350	55p
22	25	13p
22	40	16p
22	63	18p
22	100	24p
47	25	16p
47	40	20p
47	63	30p
47	100	32p
100	16	16p
100	25	18p
100	50	25p
100	63	29p
100	100	34p
220	10	18p
220	16	19p
220	25	25p
220	40	29p
220	63	34p
220	100	46p
470	16	25p
470	25	32p
470	40	38p
470	63	50p
470	100	69p
1000	16	34p
1000	25	43p
1000	40	53p
1000	63	75p
2200	16	53p
2200	25	71p
2200	50	80p
2200	63	1 54p
4700	16	87p
4700	25	99p

RADIALS (Wires one end)

µFd	V	
10	35	7p
22	10	7p
22	16	8p
47	10	8p
47	16	9p
100	10	10p
100	16	11p
220	10	13p
220	16	13p
470	10	14p
1000	10	23p
1000	16	28p
2200	10	39p
2200	16	51p
3300	10	57p
3300	16	75p
4700	10	75p
4700	16	1 09p
4700	63	2.99p
10000	16	2 99p
10000	80	4 95p

74TTL

7400	29p
7401	29p
7402	29p
7403	29p
7404	35p
7405	29p
7406	39p
7407	39p
7408	29p
7409	29p
7410	29p
7411	29p
7412	29p
7413	45p
7414	59p
7416	35p
7420	29p
7421	29p
7422	29p
7423	35p
7425	35p
7426	39p
7427	39p
7428	39p
7430	25p
7432	35p
7437	29p
7438	39p
7440	39p
7441	39p
7442	85p
7444	99p
7445	99p
7447	99p
7448	99p
7450	35p
7451	35p
7453	35p
7454	35p
7460	49p
7470	49p
7472	49p
7473	49p
7474	49p
7475	49p
7476	49p
7480	65p
7481	1.75
7482	95p
7483	95p
7484	95p
7485	95p
7486	39p
7489	1 99
7490	55p
7491	65p
7492	65p
7493	65p
7494	1 09
7495	55p
7496	55p
7497	1 99
74100	1.99
74104	49p
74107	49p
74109	69p
74110	1 99
74116	1 65
74118	99p
74119	1 79
74120	95p
74121	49p
74122	65p
74123	75p
74125	75p
74126	75p
74132	75p
74136	69p
74141	69p
74142	2.25
74143	2.25
74144	2 25
74145	99p
74147	1 75
74148	1 29
74150	1 59
74151	65p
74154	1 39
74155	89p
74156	89p
74157	89p
74159	1 75
74160	1 05
74161	1 05
74162	99p
74163	99p
74164	99p
74165	1 05
74166	1 49
74170	1 79
74172	3.95
74173	1 45
74175	99p
74176	99p
74180	99p
74181	3.25
74182	1 35
74184	1 89
74185	1.89
74190	1.25
74192	99p
74193	99p
74194	99p
74195	79p
74196	1 19
74197	1 19
74198	2 25
74221	99p

74LS TTL

74LS00	28p
74LS01	28p
74LS02	28p
74LS03	28p
74LS04	28p
74LS05	28p
74LS08	28p
74LS09	28p
74LS10	28p
74LS11	28p
74LS12	28p
74LS13	32p
74LS14	49p
74LS20	28p
74LS21	28p
74LS22	28p
74LS27	28p
74LS28	28p
74LS32	28p
74LS33	28p
74LS37	28p
74LS38	28p
74LS40	28p
74LS42	49p
74LS47	85p
74LS51	28p
74LS54	28p
74LS55	28p
74LS73	29p
74LS74	35p
74LS75	45p
74LS76	35p
74LS78	35p
74LS83	69p
74LS85	75p
74LS86	35p
74LS90	49p
74LS92	55p
74LS93	55p
74LS95	75p
74LS107	39p
74LS109	45p
74LS112	45p
74LS113	45p
74LS114	45p
74LS122	69p
74LS123	85p
74LS124	1 35
74LS125	49p
74LS126	49p
74LS132	65p
74LS138	55p
74LS139	55p
74LS145	99p
74LS147	1 75
74LS148	1.35
74LS151	65p
74LS153	65p
74LS154	1.99
74LS157	55p
74LS158	69p
74LS160	75p
74LS161	75p
74LS162	75p
74LS163	75p
74LS164	75p
74LS165	1 09
74LS166	1 95
74LS169	99p
74LS170	1 65
74LS173	99p
74LS174	99p
74LS175	75p
74LS181	1 99
74LS183	1 99
74LS190	85p
74LS191	75p
74LS192	85p
74LS194	75p
74LS195	75p
74LS196	89p
74LS197	89p
74LS221	99p
74LS240	85p
74LS241	85p
74LS242	85p
74LS243	85p
74LS244	79p
74LS245	99p
74LS247	99p
74LS248	99p
74LS249	99p
74LS251	75p
74LS253	75p
74LS257	75p
74LS258	65p
74LS259	1.19
74LS261	1 19
74LS266	55p
74LS273	1 22
74LS275	3 49
74LS279	75p
74LS280	1 89
74LS283	79p
74LS290	79p
74LS293	79p
74LS295	1.35
74LS299	2.25
74LS323	3 09
74LS324	3 25
74LS325	1.65
74LS326	2 89
74LS327	2 89
74LS347	1 35
74LS348	1 95
74LS352	1.19
74LS353	1 19
74LS362	6.85
74LS365	49p
74LS366	49p
74LS367	49p
74LS368	49p
74LS373	95p
74LS374	95p
74LS378	95p
74LS386	49p
74LS390	79p
74LS393	1 09
74LS395	99p
74LS396	2 95
74LS398	1.95
74LS399	1.49
74LS445	1.25
74LS490	1.49
74LS540	1.39
74LS541	1 39
74LS640	1 95
74LS641	1.95

CMOS

4000	19p
4001	19p
4002	22p
4006	68p
4007	25p
74LS30	28p
4011	19p
4012	25p
4013	25p
4015	55p
4016	35p
4017	52p
4018	55p
4019	55p
4020	75p
4021	52p
4022	65p
4023	39p
4024	49p
4026	1 50
4027	39p
4028	47p
4029	75p
4030	35p
4031	1 25
4032	65p
4034	1 39
4035	95p
4036	2 75
4038	85p
4040	59p
4041	55p
4042	49p
4044	49p
4045	99p
4045	59p
4047	59p
4049	35p
4050	35p
4051	65p
4052	55p
4053	55p
4054	79p
4056	79p
4059	3 95
4060	65p
4063	85p
4066	39p
4067	2.25
4068	25p
4069	25p
4070	25p
4071	25p
4072	25p
4073	25p
4075	25p
4076	65p
4077	25p
4078	25p
4081	25p
4085	55p
4086	59p
4089	1 19
4093	35p
4094	69p
4095	89p
4096	89p
4098	79p
4099	99p
4103	1 95
4502	55p
4503	35p
4505	3 50
4507	35p
4508	1 19
4510	49p
4511	49p
4512	49p
4514	1 04
4515	1 05
4516	55p
4518	45p
4519	29p
4520	49p
4521	1 09
4522	79p
4526	65p
4527	65p
4528	65p
4529	1 25
4532	65p
4534	3 49
4536	2 49
4538	75p
4543	69p
4553	2 39
4555	35p
4556	49p
4560	1 45
4569	1 65
4584	55p
4585	59p

LOGIC

CPUS

6502	3 49
6502A	5 45
6800	1 99
6802	2 49
6809	6 49
8035	5 49
8039	4 99
8035	ASK
Z80ACPU	2 95
Z80BCPU	7.59

MEMORIES

2114	1.89
2532 300N	3.49
2532 400N	3.45
2564	6 49
2708	2 99
2716	3 45
2732	4 35
2764	5 19
27128	15 95
4116 150N	1.25
4118	4 65
6116	4.95
6810	1 55

MISC LOGIC

ADC0804	5.05
ADC0816	18 69
ADC0817	11 55
SAA5000	6.13
SAA5010	6 13
SAA5012	6 13
SAA5020	3 79
SAA5030	6 04
SAA5040	11.36
SAA5041	15 14
SAA5050	6 38
SAA5070	16 21
8T26	1 09
8T28	1.09
8T95	1 09
8T97	1 09
81LS95	2 35
81LS97	2 35
81LS96	2 35
81LS98	2 35
6522	3 49
6522A	5 45
6532	5.25
6821	1.55
6840	3 75
6845	6 49
6847	6 49
8154	ASK
8155	ASK
8212	4 85
8216	ASK
8224	ASK
8226	ASK
8255	ASK
Z80ACTC	2 99
Z80ADART	7 99
Z80APIO	3.19
ZN425E8	3.49
ZN426E8	7 99
ZN427E8	5 99
ZN428E8	4.55

V REGS

Positive 100mA

78L05A	29p
78L12A	29p
78L15A	29p
78L24A	29p

1 Amp TO220

7805T	49p
7812T	49p
7815T	49p
7824T	49p

Negative 100mA TO92

79L05	49p
79L12	49p
79L15	49p

1 Amp TO220

7905T	65p
7912T	65p
7915T	65p
7924T	65p

TRANSISTORS

2N2219	33p
2N2219A	36p
2N2222	29p
2N2222A	33p
2N2369	34p
2N2369A	35p
2N2904A	35p
2N2905	35p
2N2905A	38p
2N3053	35p
2N3054	65p
2N3055	65p
2N3055H	1 89p
2N3439	1 15p
2N3440	99p
2N3441	1 49p
2N3442	1 59p
2N3553	2.65p
2N3702	16p
2N3703	16p
2N3704	16p
2N3705	16p
2N3706	16p
2N3707	16p
2N3819	35p
2N3820	80p
2N3866	1 20p
2N3903	19p
2N3904	19p
2N3905	19p
2N3906	19p
2N4036	72p
2N4037	66p
2N4240	3.00p
2N4400	19p
2N4401	33p
2N4402	37p
2N4427	1 80p
2N4870	99p
2N4871	75p
2N5245	46p
2N5246	59p
2N5247	63p
2N5248	65p
2N5249	67p
2N5296	1 75p
2N5298	1.68p
2N5401	57p
2N5415	1.36p
2N5416	1.73p
2N5447	29p
2N5448	31p
2N5449	27p
2N5450	63p
2N5451	66p
2N5457	39p
2N5458	39p
2N5459	31p
2N5460	83p
2N5551	41p
2N5657	1.99p
2N5684	13.95p
2N5884	5.95p
2N5886	5.95p
2N6027	60p
2N6030	9 70p
2N6031	10.90p
2N6058	3.50p
2N6059	3.86p
2N6121	1.48p
2N6122	1 52p
2N6123	1 58p
2N6124	1 65p
2N6125	1.71p
2N6126	1 77p
2N6129	1 57p
2N6130	1 62p
2N6131	1 75p
2N6132	1.82p
2N6133	1.89p
2N6134	1.99p
2N6212	3 45p
2N6254	1 99p
2N6387	1 89p
2N6676	17.82p
2SC1306	99p
2SC2078	1 70p
2SD313	2 65p
2SJ49	4.95p
2SJ50	5.29p
2SK134	4.95p
2SK135	5 29p
3N201	1.99p
40250	1 95p
40361	75p
40362	75p
40363	3.99p
40406	1.75p
40408	1 75p
40410	1.99p
40411	4.29p
40594	1 40p
40595	1.40p
40673	1.49p
40822	1.99p
40871	1.15p
40872	1.15p
AC125	99p
AC126	35p
AC127	35p
AC128	39p
AC141K	39p
AC142K	39p
AC176	39p
AC176K	49p
AC187	39p
AC188	39p
AC187K	49p
AC188K	49p
AD161	55p
AD162	55p
BC107	16p
BC107A	17p
BC107B	19p
BC108	16p
BC108A	17p
BC108B	18p
BC108C	20p
BC109	17p
BC109B	18p
BC109C	21p
BC140	38p
BC141	43p
BC147	15p
BC148	15p
BC149	16p
BC157	39p
BC158	37p
BC158	44p
BC160	55p
BC161	59p
BC169	19p
BC169C	23p
BC177	29p
BC178	29p
BC179	31p
BC182	15p
BC182L	15p
BC183	14p
BC183L	15p
BC184	16p
BC212	16p
BC213	17p
BC213L	15p
BC214	18p
BC214L	19p
BC300	59p
BC301	59p
BC302	59p
BC303	59p
BC327	16p
BC394	52p
BC440	35p
BC441	37p
BC447	33p
BC448	33p
BC449	39p
BC460	38p
BC461	42p
BC478	38p
BC479	38p
BC546	16p
BC547	19p
BC548	16p
BC549	17p
BC550C	29p
BC557	19p
BC559	18p
BC560C	29p
BC639	37p
BC640	37p
BC650	45p
BC651	47p
BCY70	31p
BCY71	33p
BCY72	25p
BD131	63p
BD132	63p
BD135	38p
BD136	38p
BD137	39p
BD138	39p
BD139	42p
BD140	42p
BD237	98p
BD238	98p
BD239A	65p
BD239C	69p
BD240A	68p
BD240C	79p
BD241A	72p
BD241C	79p
BD242A	75p
BD242C	79p
BD243A	85p
BD243C	89p
BD2244A	88p
BD244C	1.15p
BD245C	1.19p
BD245C	1 49p
BD246C	1 67p
BD249A	2.30p
BD249C	2.57p
BD250A	2.48p
BD250C	2 75p
BD410	1 65p
BD419	1.75p
BD420	1.85p
BD433	69p
BD434	75p
BD435	81p
BD437	88p
BD438	88p
BD439	90p
BD440	91p
BD441	91p
BD442	93p
BD529	1 75p
BD530	1.95p
BD535	89p
BD536	89p
BD537	97p
BD538	97p
BD539	1.08p
BD540	1.04p
BD651	1 95p
BD652	1.95p
BD675	85p
BD676	87p
BD677	89p
BD678	99p
BD679	99p
BD680	1 35p
BD711	1 50p
BD712	1 50p
BDX32	3 59p
BDX33A	1 29p
BDX33C	1 59p
BDX34A	1.29p
BDX34C	1.59p
BDX66B	6 35p
BDX67B	6 35p
BDY54	2 28p
BDY55	2 39p
BDY56	1.99p
BDY57	5 91p
BDY58	6 33p
BF179	83p
BF180	46p
BF198	18p
BF199	18p
BF200	79p
BF244A	61p
BF244B	55p
BF245A	63p
BF245B	66p
BF246	77p
BF246A	79p
BF246B	79p
BF257A	79p
BF247B	79p
BF254	66p
BF255	68p
BF256A	59p
BF256B	59p
BF256C	69p
BF257	39p
BF258	41p
BF259	45p
BF457	48p
BF458	59p
BF459	65p
BF900	1 09p
BF961	1 55p
BFR90	2 25p
BFR91	2 75p
BFS61	99p
BFS98	99p
BFT66	2 75p
BFX29	44p
BFX30	46p
BFY50	36p
BFY51	36p
BFY52	36p
BSV81	2.65p
BSX19	29p
BSX20	33p
BSX21	49p
BU104	2.32p
BU105	1.89p
BU108	2,49p
BU109	2 49p
BU126	1 55p
BU204	2.49p
BU205	1 99p
BU206	2.16p
BU208	1,93p
BU226	4 45p
BU326S	2 63p
BU406	1 45p
BU407	1 58p
BU408	1 49p
BU409	1.65p
BU500	3.56p
BUX48	6.75p
BU126	1.55p
BUY18S	4.33p
E430	6 32p
IRF530	4 95p
J300	88p
J310	88p
MJ802	4.25p
MJ900	3.21p
MJ901	3.39p
MJ1000	2 76p
MJ1001	3.26p
MJ1800	3 79p
MJ2500	2 39p
MJ2501	2.63p
MJ2955	99p
MJ3000	2.39p
MJ3001	2.63p
MJ4502	4.25p
MJE340	75p
MJE350	1.49p
MJE2955	1 99p
MJE2955T	95p
MJE3055	1 99p
MJE3055T	69p
MPSA05	29p
MPSA06	33p
MPSA12	49p
MPSA13	49p
MPSA14	49p
MPSA20	49p
MPSA42	49p
MPSA43	48p
MPSA55	29p
MPSA56	33p
MPSA92	49p
MPSA93	48p
MPSL01	69p
MPSL51	75p
MPSU05	89p
MPSU06	99p
MPSU07	1 75p
MPSU56	1 22p
MPSU57	1.95p
TIP29A	35p
TIP29C	42p
TIP30A	37p
TIP30C	44p
TIP31A	39p
TIP31C	47p
TIP32A	46p
TIP32C	49p
TIP33A	69p
TIP33C	83p
TIP34A	1 19p
TIP34C	1 26p
TIP35A	1 26p
TIP35C	1 39p
TIP36A	1.42p
TIP36C	1 49p
TIP41A	52p
TIP41C	58p
TIP42A	62p
TIP42C	65p
TIP49	1 29p
TIP50	1 52p
TIP53	1 58p
TIP54	1 65p
TIP110	79p
TIP112	85p
TIP115	89p
TIP117	1 05p
TIP120	79p
TIP122	85p
TIP127	99p
TIP130	1 06p
TIP132	1 09p
TIP135	1 16p
TIP137	1 19p
TIP140	1 21
TIP142	1 22p
TIP145	1 21p
TIP147	1 22p
TIP162	4 99p
TIP2955	81p
TIP3055	79p
TIS43	61p
VN10KM	69p
VN46AF	1.15p
VN66AF	1 09p
ZTX107	16p
ZTX108	15p
ZTX109	18p
ZTX300	16p
ZTX301	17p
ZTX302	18p
ZTX303	19p
ZTX304	21p
ZTX310	22p
ZTX312	23p
ZTX313	24p
ZTX314	27p
ZTX320	22p
ZTX330	26p
ZTX341	25p
ZTX450	22p
ZTX500	18p
ZTX501	19p
ZTX502	20p
ZTX503	21p
ZTX504	22p
ZTX510	22p
ZTX531	26p
ZTX650	36p
ZTX651	38p
ZTX652	42p
ZTX653	45p
ZTX750	37p
ZTX751	41p
ZTX752	45p
ZTX753	47p

DIODES

1N34A	52p
1N914	4p
1N916	6p
1N4001	4p
1N4002	4½p
1N4003	5p
1N4004	5½p
1N4005	6p
1N4006	6½p
1N4007	7p
1N4148	3p
1N5401	13p
1N5402	14p
1N5404	16p
1N5406	18p
1N5407	19p
1N5408	20p
BA102	49p
BA115	29p
BA133	51p
BA138	36p
BA155	18p
BA156	41p
BA157	28p
BA158	34p
BA159	38p
BA182	49p
BA201	23p
BA202	29p
BA316	27p
BA317	28p
BA318	31p
BAX13	21p
BB105	65p
BB109G	69p
BY126	12p
BY127	14p

SCR's TRIACS DIACS

THYRISTORS 4 8 & 12 Amps Texas TO220

Suffix A –	100 V
Suffix B –	200 V
Suffix C	300 V
Suffix D	400 V
Suffix M –	600 V

4A	
TIC106A	66p
TIC106B	67p
TIC106C	68p
TIC106D	69p
TIC106M	75p
8A	
TIC116A	88p
TIC116B	89p
TIC116C	93p
TIC116D	97p
TIC116M	99p
12A	
TIC126A	86p
TIC126B	87p
TIC126C	88p
TIC126D	89p
TIC126M	99p

TRIACS Texas 400V TO220 Case

TIC206D (4A)	79p
TIC225D (6A)	89p
TIC226D (8A)	91p
TIC236D (12A)	1 25p
TIC246D (16A)	1 49p
TIC253D (20A)	2.69p
TIC263D (25A)	2 95p

DIACS

BR100,DB3, ST2	29p

ZENER'S

Many specials in stock Pls enquire

400 to 500mW E24 Series 2 4 to 47V	7p
1 3 Watt E24 Series 3 3 to 82V	14p

BRIDGE

(PIV shown in brackets)

1½ amp type

WO1(100)	28p
WO2(200)	34p
WO4(400)	33p

2 amp type Square with hole

SO1(100)	46p
SO2(200)	50p
SO4(400)	55p

6 amp Square with hole

PW01(100)	95p
PW02(200)	99p
PW04(400)	1.30p
PW06(600)	1.39p

25 amp type Metal clad with hole

KO1(100)	2 62p
KO2(200)	2 75p
KO4(400)	3 25p
KO6(600)	4.10p
BYW64 35A 400W	4 50p

OPTO

Many weird & wonderful devices in stock, inc var shapes & sizes of LEDS

R Red
G Green
Y Yellow

Large diffused 1 +

R5D	10p
G5D	16p
Y5D	15p

Small diffused

R3D	8p
G3D	13p
Y3D	13p

Micro 0 1"

R1M	27p
G1M	29p
Y1M	29p

Large clear

R5C	12p
G5C	17p
Y5C	17p

Super bright high efficiency Large (100 times brighter)

R5U	42p
G5U	47p
Y5U	47p

Rectangular Stackable LEDS

R5R	19p
G5R	20p
Y5R	22p

LIN ICs

AY15050	99p
AY38910	3 99p
AY38912	4 95p
CA3048	2 15p
CA3059	3 65p
CA3090AQ	3 70p
CA3130E	87p
CA3130T	2 35p
CA3140E	54p
CA3140T	1 40p
HA1366W	2 40p
HA1388	2 54p
ICL7106	7 50p
ICL7107	9 50p
ICL7611	97p
ICL8038	3 50p
ICM7555	1 10p
ICM7556	1 49p
LF347	1 78p
LF351	75 p
LF353	1 15p
LF355	1 25p
LF356	1 35p
LF357	1.65p
LF398	5 50p
LM301AN	45p
LM304H	1 75p
LM307N	45p
LM308N	99p
LM309K	1 99p
LM317K	2 80p
LM317HVK	10 80p
LM324	pls ask
LM335Z	1 60p
LM343N	99p
LM349N	1 09p
LM379S	5 50p
LM380N14	pls ask
LM380N8	pls ask
LM381AN	2 26p
LM318N	1 40p
LM382N	1 79p
LM383T	3 40p
LM384N	2 90p
LM386	1 25p
LM386N	1 20p
LM387	pls ask
LM388N	2 43p
LM391N60	2 25p
LM391N80	2 64p
LM392	99p
LM396K	14 95p
LM723CH	1 08p
LM723CN	59p
LM725CH	3 40p
LM725CN	3 19p
LM741CH	99p
LM741CN	28p
LM741CN14	1 20p
LM747CN	69p
LM748CH	99p
LM748CN	55p
LM1877	7 95p
LM1886	7 44p
LM1889	4 65p
LM2902	2 78p
LM2907N	3 96p
LM2907N8	3 96p
LM2917N	3 20p
LM2917N8	3 20p
LM3900	79p
LM3911	1 45p
LM3914	3 25p
LM3915	3 25p
LM4250	2 89p
LM13600	1 50p
LM13700	1 50p
MC1408	3 65p
MC1466L	16 50p
MC1468	4 30p
MC3340	2 95p
MC3446	3 95p
MC3357	3 65p
MC4044	5 95p
MF10	4 50p
NE529	2 25p
NE531N	1 36p
NE543N	2 50p
NE544N	1 95p
NE555	28p
NE556	69p
NE558	1 89p
NE560	3 25p
NE565	1 18p
NE566	1 49p
NE567	1 37p
NE570	5 00p
NE571	5 25p
NE5534A	1 95p
RC4194	3 95p
RC4195	2 95p
RC4558	44p
SN76477	7 95p
SN76003	3 45p
SN76013	3 45p
SN76023	3 45p
SN76033	3 45p
TA7204	1 99p
TA7205	1 20p
TA7222	1 75p
TA7227	5 82p
TBA500	2 97p
TBA510	2 95p
TBA520	2 57p
TBA530	2 55p
TBA540	2 72p
TBA550	3 25p
TBA560C	2 87p
TBA570	2 37p
TDA1002	3 39p
TDA1003	4 35p
TDA1010A	2 25p
TDA1022	4.95p
TDA1097	4 99p
TDA 1151	1 95p
TDA2002	3 25p
TDA2003	3 25p
TDA2020	3 15p
TDA2030	2 85p
TDA2611	2 50p
TDA7000	3 45p
TL061	51p
TL062	77p
TL064	1 50p
TL071	47p
TL072	62p
TL074	1 50p
TL081	47p
TL082	55p
TL084	1 20p
TL494	3 99p
UAA170	2 49p
UAA180	2.49p
UAA240	1 25p
ULN2003	1.15p
UPC575C2	2 00p
UPC1156H	2 75p
UPC1182	3 75p
UPC1185	3 95p
UPC1185H	3 65p
UPC1212C	1 60p
UPC2002	3 25p
XR2206	3 95p
ZN409	2 25p
ZN414	1 00p
ZN1034	1 99p

TRANSFORMERS

Post inclusive prices cheaper to callers All 240V Primary Split Bobbin 100mA

6-0-6	1 50p
9-0-9	1 70p
12-0-12	1 85p
15-0-15	1 95p
1A as above	3 75p
20 0 20V 0 125A	3 75p
12 0 12V 50VA	7 95p
12 0 12V 100VA	11 99p
0 + 6 + 6 + 9 + 9 1 25A	5 65p

VERO

0 1" COPPER TRACKS

2 5 x 3 75	95p
2 5 x 5	1 10p
3 75 x 3 75	1 10p
3 75 x 5	1 24p
2 5 x 17	3 27p
3 75 x 17	4 29p
4 79 x 17	5 56p
VQ Board	2 10p
DIP Board	3 95p
Track Cutter	1 63p
Pin Insertor	2 21p
100Pins	61p
Verobloc	4 66p
Vero Wiring Pen & Spool	3 39p
Spare Spool	75p
Combs	6p

PCB

FERRIC CHLORIDE Quick dissolving Enough to make over 1 litre 1 75p

ETCH RESIST TRANSFERS
1 Thin lines
2 Thick lines
3 Thin bends
4 Thick bends
5 DIL pads
6 Transistor pads
7 Dots & holes
8 0 1" edge connectors
9 Mixture
Any sheet of above 39p

GRADE ONE GLASS PCB SINGLE SIDED

178 × 240mm	1 85p
420 × 195mm	2 55p
420 × 245mm	3 75p

DALO ETCH RESIST PEN + spare nib 1 29p

PHOTO SENSITIVE PCB 1st Class Epoxy Glass for better results than spraying expose to UV

Single sided	
100 × 160	2 10p
100 × 220	2 50p
203 × 114	2 40p
233 × 220	5 20p
Double sided	
100 × 160	2 20p
100 × 200	2.90p
203 × 114	2 20p
233 × 220	5.90p

Developer for above (do not use Sodium Hydroxide) 500ml 295p

WIRE

PRICES PER METRE

Solid connecting wire

MAINS SPEAKER

Twin 1 Amp	16p
Twin 2½ Amp	19p
3 Core 2½ Amp	21p
3 Core 13Amp	62p

SCREENED

Single	16p
Stereo	29p
Mini Single	13p
Mini Stereo	16p
4 Core 4Screens	49p
4 Core Single Screen	62p
8Core	73p
12Core	88p
Heavy Duty Mike Guitar Lead	33p

AERIAL

50Ω RG58A	29p
75Ω UHF	31p
75Ω VHF	31p
300Ω Flat	16p

RAINBOW RIBBON Prices per foot

10way	25p
16way	39p
20way	48p
24way	62p
30way	75p
34way	82p
40way	88p
64way	1 49p

SOLDER

ANTEX SOLDERING IRONS

C250 (15W)	5.60p
XS250 (25W)	5.90p
Iron Stand	1.99p
Elements (State Iron)	2.50p

C240 Bits

No 2 (Small)	99p
No 3 (Med)	99p
No 6 (Micro)	99p

XS240 × 25 Bits

No 50 (Small)	99p
No 51 (Lge)	99p

SOLDER 125 gms

18swg	2.95p
22 swg	3.10p

PLUGS & SOCKETS

'D' Connectors 25 Way Solder

Male	1 60p
Female	2 09p

PCB Wire-Wrap

Male	1 60p
Female	2 09p
Covers	1 00p

Phono plugs

Blk, Red, Grn, Wt or Yell	15p
Line Skts	15p
Chas Sktx 1	16p
Dual Skt	30p
Quad Skt	40p

ZIF SOCKET

24pin	4 35p
28pin	5 00p
40pin	5 35p

SWITCHES

TOGGLE (MIN)

SPST	59p
SPDT	65p
DPDT	74p
DPDT C OFF	90p
4PDT	3 25p

ELECTRONIC SIREN KIT

Produces an extremely loud piercing swept frequency tone from a 9-15V supply. Enable input for easy connection to alarm circuits. Includes 5in. Horn Speaker. **£7.90**

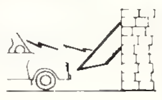
Mini Siren
As above, but with a small speaker (instead of horn speaker) for internal use. **£4.30**

SECURITY PRODUCTS

Protect your home and property and save by building your own burglar alarm system

Stair Mat 23 × 7 in (950 120) **£1.70**
Floor Mat 29 × 16 in (950 125) **£2.60**
Tamper-proof connecting block (950 110) **£0.30**
Door/Window Contacts. Flush mounting, 4 wire, Magnet/switch Per Pair. (950 140) **£1.05**
Window Tape 0.5" wide. 50m. (950 145) **£2.50**
Window Tape Terminations Per pair. (950 150) **£0.36**
Key-operated Switch. 1 5A 250V SPST Heavy chrome metal. (350 128) **£4.50**
Passive Infra-Red Detector Detects intruder's body heat. Range 10 metres. 12V DC, n/o & n/c contact Size: 4 × 2 × 2 ins. (950 135) **£45.00**
Alarm Control Unit. 4 input circuits, 2-instant and 2-delayed Adjustable entry, exit and alarm times. Built and tested. Full instructions supplied. Size: 180 × 130 × 30mm. Supply: 12V DC. (950 160) **£26.00**
Ultrasonic Burglar Alarm. Self-contained mains or battery powered unit complete with horn and AC adaptor. **£45.00** + p&p £2.20
8W Horn Speaker. 5.5 ins. 8 ohm. Ideal for sirens, etc. 2.5m lead and 3.5mm jack plug. (403 148) **£6.15**

IR GARAGE DOOR CONTROLLER KIT



For controlling motorised garage doors and switching garage and drive lights on/off up to a range of 40 ft

Lots of applications like controlling lights and TVs, etc, in the home. Ideal for aged or disabled persons, this coded kit comprises of a mains-powered infra-red receiver with a normally open relay output plus two latched transistor outputs, battery-powered transmitter and opto-isolated solid state mains switch.

XK103		**£25.00**
XK105	Extra transmitters	**£10.50**

PANTEC KITS

PN2	FM Micro Transmitter	**£7.50**
PN3	Stabilised Power Supply	**£13.70**
PN5	2 × 10w Stereo Amplifier	**£14.50**
PN6	2 × 40w Stereo Amplifier	**£24.95**
PN7	Pushbutton Stereo Preamp	**£12.80**
PN8	Tone & Volume Control	**£13.60**
PN11	3w FM Transmitter	**£11.95**
PN13	Single Channel FM Transmitter	**£9.80**
PN14	Receiver for above	**£15.50**

TOP QUALITY . . . TOP SERVICE
BOTTOM PRICES!

For FREE CATALOGUE send 9" × 6" SAE — contains full list of stock range all at very competitive prices. Cash with order (except account customers). Access or Barclaycard telephone orders welcome. Add 65p p&p + 15% VAT to all UK orders. Overseas customers add £2.50 p&p Europe, £6.00 elsewhere. Giro No. 529314002. Goods by return subject to availability. Shop open 9am — 5pm (Mon-Fri). 10am — 4pm Sat). ALL PRICES EXCLUDE VAT

CHRISTMAS PRESENTS GALORE

BEGINNERS' PROJECTS PACK
Contains solderless breadboard, components and booklet with instructions to build TEN fascinating electronic projects, e.g. thermostat, burglar alarm, light operated switch, electronic lock, touchswitch, siren. Requires 9V PP3 battery. **£12.50**

MW RADIO KIT
Based on ZN414 IC, kit includes PCB, wound aerial and crystal earpiece and all components to make a sensitive miniature radio. Size 5 5 x 2 7 x 2 cms Requires PP3 9V battery. IDEAL FOR BEGINNERS **£5.50**

3-NOTE DOOR CHIME
Based on SAB0600 IC the kit includes all components, loudspeaker, PCB, pre-drilled box (95 × 71 × 35mm) and full instructions. Requires a 9V battery and pushswitch. IDEAL PROJECT FOR BEGINNERS. Order as XK102. **£5.50**

20kV MULTIMETER
19 ranges including 10A dc. Resistance to 10M, ac & dc volts to 1kV Battery checker and continuity buzzer. Size: 135 × 89 × 40mm (405 104) **£11.75**

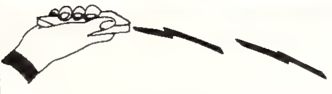
DIGITAL MULTIMETER
19 ranges including dc current to 10A, resistance to 20M, ac & dc volts and npn/pnp transistor gain. Full overload protection. Comes with test leads, battery and case. Size: 175 × 93 × 42mm (405 204) **£32.00**

20kV MULTIMETER
23 range quality multimeter with 12A dc current, ac and dc volts to 1200V, resistance to 1M and dB scale. Transistor gain and leakage scales, battery tester. Size: 155 × 102 × 56mm (405 106) **£16.95**

STOCKING FILLERS All full spec. branded devices.

PACK (1) 650 Resistors 47 ohm to 10Mohm — 10 per value £4.00
PACK (2) 40 x 16V Electrolytic Capacitors 10μF to 1000μF £3.25
PACK (3) 60 Polyester Capacitors 0.01 to 1μF/250V — 5 per value £5.55
PACK (4) 45 Sub-miniature Presets 100 ohm to 1 Mohm — 5 per value £2.90
PACK (5) 30 Low Profile IC Sockets 8, 14, and 16 pin — 10 of each £2.40
PACK (6) 25 Red LEDs (5mm dia.) £1.50

INFRA-RED REMOTE CONTROL KITS



These kits are designed to enable infra-red remote control to be incorporated into virtually any application from switching car locks or alarms to controlling Hi-Fi or TV. The application will determine the interface circuitry between the receiver and the controlled device. General instructions and applications are supplied. The kits are coded and provide a high degree of security and noise immunity.

MK 18 Transmitter Kit — for use with MK11/MK12 receivers. Requires PP3 battery. Size: 8 × 2 × 13cms. Range approx 60 ft. **£6.80**

Keyboards for MK18

MK9	4-way for use with MK12	**£1.90**
MK10	16-way for use with MK12	**£5.40**
MK13	11-way for use with MK11	**£4.35**

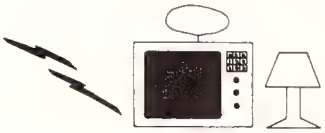
MK11 Receiver Kit — mains powered. Provides 10 latched plus 3 analogue outputs ideal for controlling audio amplifiers, TV or lighting where control of light brightness is required. **£13.50**

MK14 AC Power Controller Kit — for (phase) controlling AC loads from MK11 analogue outputs, eg lamp dimming. **£5.20**

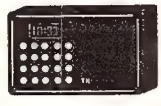
MK19 Stereo Amplifier Controller Kit — for remote control of bass, treble and volume (or balance) by MKII. Includes a one of 10 decoder remote channel or input selection. May be connected between the pre-amp and power amp of almost any audio system. **£10.70**

MK12 Receiver Kit — mains powered with 16 latched or momentary outputs. Latched version is for applications requiring one output on at a time, eg TV channel selection. Momentary type gives an output only during transmission. Lines may be latched as required.
Size: 9 × 4 × 2cms. **£13.50**

MK15 Dual Latched Solid State Relay — for switching mains loads such as lamps, TVs, etc, from the outputs of the MK12 (momentary). 15 items may be switched independently using 8 MK15s. Triacs (not supplied) switch at mains zero to reduce interference. **£4.50**



MICROPROCESSOR TIMER KIT



Designed to control 4 outputs independently switching on and off at preset times over a 7-day cycle. LED display of time and day, easily programmed via 20-way keyboard. Ideal for central heating control (including different switching times for weekends). Battery back-up circuit. Includes box.
18 time settings.

CT6000K		£39.00
XK114.	Relay Kit for CT6000 includes PCB, connectors and one relay. Will accept up to 4 relays. 3A 240V c/o contacts	£3.90
701 115	Additional Relays	£1.65

ELECTRONIC LOCK KIT

With hundreds of uses indoors, garages, car anti-theft devices, electronic equipment, etc. Only the correct easily changed four-digit code will open it! Requires a 5-15V DC supply. Output 750mA. Fits into standard electrical wall box.
Complete kit (except front panel)
XK101 **£11.50**
Electric Lock Mechanism for use with existing door locks and the above kit. (Requires relay.) 12V AC/DC coil. (701 150) **£14.95**

HOME LIGHTING KITS

These kits are designed to replace a standard wall switch to control up to 300w of lighting.

TDR300K	Remote Controlled Light Dimmer	£14.95
MK6	Transmitter for above	£4.50
TD300K	Touch Dimmer	£7.75
TS300K	Touch Switch	£7.75
TDE/K	2-way extension for above kits	£2.50
LD300K	Rotary controlled Light Dimmer	£3.95

DISCO LIGHTING KITS

DL1000K — This value-for-money 4-way chaser features bi-directional sequence and dimming. 1kW per channel. **£15.95**
DLZ1000K — A lower cost uni-directional version of the above. Zero switching to reduce interference. **£8.95**
Optional opto input allowing audio 'beat'/light response **(DLA/1)** **70p**
DL3000K — 3-channel sound to light kit features zero voltage switching, automatic level control and built-in microphone. 1kW per channel. **£12.95**

OTHER KITS

CT1000K	Clock/Timer	**£14.90**
CT1000KB	Clock/Timer + Box	**£17.40**
XK126	DVM/Thermometer	**£15.50**
MK1	Thermostat	**£4.60**
MK2	Solid State Relay	**£2.60**
MK4	Temperature Control	**£6.50**
MK5	Mains Timer	**£6.50**
MK6	Infra Red Transmitter	**£4.50**
MK7	Infra Red Receiver	**£10.50**

All kits include PCBs, components and assembly instructions.
For further details send S.A.E.

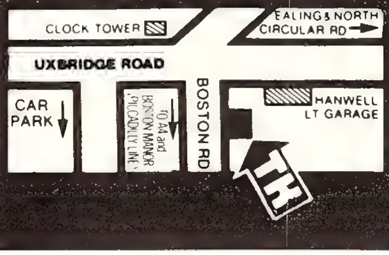
TK ELECTRONICS

11-13 Boston Road
London W7 3SJ

ORDERS
01-567 8910

ENQUIRIES
01-579 9794

01-579 2842 TECHNICAL AFTER 3pm


CLOCK TOWER
EALING & NORTH CIRCULAR RD
UXBRIDGE ROAD
CAR PARK
TO A4 and BOSTON MANOR PICCADILLY LINE
BOSTON RD
HANWELL LT GARAGE
TK

"Run more than ten tasks on a ZX81-FORTH ROM?"

Sure! More than 10 tasks simultaneously and, in some cases, up to 300 times faster! That's what replacing the basic ROM with the new Forth does or the ZX81 — and more!

The brains behind the reakthrough belong to David Iusband, and he's building Skywave Software on the strength f it. Already orders are flooding n and it's easy to see why.

The ZX81-FORTH ROM gives ou a totally new system. In ddition to multi-tasking and split creen window capability, you an also edit a program while hree or four others are executing, chedule tasks to run from 50 imes a second to once a year, and vith a further modification switch etween FORTH and BASIC vhenever you like.

The ZX81-FORTH ROM gives you a normal keyboard with a 64 character buffer and repeat, it supports most 16k, 32k, 64k RAM packs, it is fig-FORTH compatible and it supports the ZX printer.

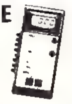
The price, too, is almost unbelievable. As a "fit it yourself Eprom", complete with manual, it's just £25+VAT. Add £3 p&p UK (£6 Europe, £12 outside Europe) and send your order to the address below.

Skywave
SOFTWARE

David Husband
73 Curzon Road, Bournemouth,
BH1 4PW, ENGLAND.Tel: (0202) 302385.
International +44 202 302385.

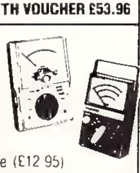
10% DISCOUNT VOUCHER

SEND THIS VOUCHER WITH YOUR ORDER OR BRING IT WITH YOU!



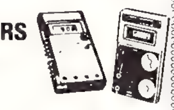
DIGITAL CAPACITANCE METER (UK C/P 65p)
Large LCD display 8 ranges 0 lpf to 2500 mfd (£69 50)
WITH VOUCHER £62.55

DC POWER SUPPLIES
220/240 AC input
(UK C/P £1 00)
1203 13 8 volt 3 Amp DC output (For all 12 volt DCequipment) £11 95 **WITH VOUCHER £10.76**
241 Meter indicator Amps/Volts 0/30 Volt 0/1 Amp (£37 95) **WITH VOUCHER £34.16**
243 3 Amp version (£59 95) **WITH VOUCHER £53.96**



ANALOGUE MULTIMETERS
(UK C/P 65p)
HC 1015 10K/volt 15 Range pocket (£8 95) **WITH VOUCHER £8.06**
NH56R 10K/volt 22 Range (£12 95) **WITH VOUCHER £11.66**
102BZ 20K/volt 22 Range 10A DC (£15 95) **WITH VOUCHER £14.36**
YN360TR 20K/volt 19 Range plus Hfe test (£14 50) **WITH VOUCHER £13.05**
5001 50K/volt Range doubler 10A DC20M ohm (£21 95) **WITH VOUCHER £19.76**
830A 30K/V 26 range 10A AC/DC 10 ohm (£24 95) **WITH VOUCHER £22.46**

Prices correct at time of press approximately 6 weeks prior to publication. E&OE .



DIGITAL MULTIMETERS
(UK C/P 65p)
S = Slide switches
R = Rotary
PB = Push button
- **KD305** (S) 14 Range 10A DC 2M ohm (£29 80) **WITH VOUCHER £26.82**

6010 (PB) 28 Range 10A AC/DC 20M ohm (£43 50) **WITH VOUCHER £39.15**
- **KD 55C** (R) 26 Range 10A AC/DC 20M ohm (£44 50) **WITH VOUCHER £40.05**
- **3510** (R) Range10A AC/DC 20M ohm Hfe tester cont buzzer (£46.52 ; **WITH VOUCHER £41.89**

ME540 (R) Man/Auto 19 Range 10A AC/DC 20M ohm (£47.77) **WITH VOUCHER £42.99**
- **DM3350** (R) Autorange 18 Range 10A AC/DC 2M ohm Cont Buzzer £49 95) **WITH VOUCHER £44.96**
- WITH CARRY CASE

TRANSISTOR TESTER
(UK C/P 65p)
Direct reading of Hfe and leakage for NPN/PNP transistors & diodes (£27 95) **WITH VOUCHER £25.16**

PROBE KIT (UK C/P 45p) For all scopes etc BNC connector switchable X1-X10 in wallet (£11 50) **WITH VOUCHER £10.35**

SIGNAL INJECTOR (UK C/P 45p)
Pencil type AF/RF output 1000 s sold (£4 95) **WITH VOUCHER £4.46**

HENRY'S
301 EDGWARE ROAD LONDON W2 1BN
TELEPHONE: 01-724 3564
404 EDGWARE ROAD LONDON W2 1ED
TELEPHONE: 01-724 0323

All prices include VAT
Open 6 days a week

10% DISCOUNT VOUCHER B

NOTE: Offer closes 31 1 85 Applies only for goods as above (while stocks available prepaid by post or for callers (one voucher per total order) Voucher **must** accompany order (UK C/P extra as indicated)

Magazines are valuable! Keep yours in good condition in

THE ELEKTOR CASSETTE BINDER

This cassette style binder will help to keep your copies of Elektor Electronics clean and in order, even though you refer to them time and time again. The chamfered corner of the cassette allows instant recognition of each month's issue without the need to thumb through pages of previous months' issues. Because no wires or fastenings are used copies can be easily removed and replaced and each cassette will hold one year's volume of Elektor Electronics.

PRICE £3.10
+55p P&P U.K.
(£1.10 outside U.K.)

available from —
Elektor Publishers Limited,
10 Longport,
Canterbury,
Kent CT1 1PE.
please use the order card
in this issue.

EAST CORNWALL COMPONENTS

NEW 1984 CATALOGUE NOW AVAILABLE – Many prices reduced – range increased – 123 pages fully illustrated. Price 65p, per copy (free upon request with orders over £5) – includes 30p. Credit Note, special offer sheets, order form and pre-paid envelope. **SEND NOW FOR YOUR COPY.**

VALVES

Type	Price (£)
DY802	0.88
DY86/87	0.75
ECC81	0.95
ECC82	0.65
ECC83	0.75
ECC84	0.65
ECC85	0.90
ECC88	0.95
ECF80	0.95
ECH81	0.75
ECH84	0.75
ECL82	0.75
ECL86	0.98
EF80	0.65
EF86	1.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	2.50
EL84	0.69
EL509	5.50
EM87	2.55
EY86/87	0.67
EY500A	1.65
PCC84	0.50
PCC85	0.65
PCC89	0.74
PCC189	0.85
PCF80	0.75
PCF86	1.25
PCF200	1.95
PCF801	1.45
PCF802	0.85
PCF806	1.20
PCL82	0.90
PCL83	2.50
PCL84	0.90
PCL86	0.98
PCL805/85	1.35
PD500	3.75
PFL200	1.35
PL33	1.50
PL36	1.45
PL81	0.85
PL82	0.75
PL83	0.65
PL84	0.75
PL95	2.00
PL504	1.20
PL508	2.40
PL509/519	5.95
PY88	1.80
PY500A	2.40
U26	1.90
UCH81	0.90
UCL82	1.70
6J5GT	1.75
6SJ7	2.20
30FL12	1.60

TRANSISTORS + DIODES

Type	Price (£)
AC127	0.30
AC128	0.30
AC128K	0.34
AC132	0.55
AC141	0.26
AC141K	0.40
AC142	0.26
AC142K	0.48
AC151	0.45
AC152	0.45
AC176	0.28
AC176K	0.46
AC187	0.42
AC187K	0.48
AC188	0.44
AC188K	0.50
ACY40	0.88
AD142	1.10
AD143	1.10
AD149	0.96
AD161	0.42
AD162	0.42
AD161/AD162	0.98
AF106	0.48
AF114	2.10
AF115	2.10
AF116	2.10
AF117	2.10
AF118	0.85
AF121	0.62
AF124	0.48
AF125	0.48
AF126	0.48
AF127	0.48
AF139	0.68
AF178	0.68
AF239	0.68
AF279S	0.75
AL100	2.50
AL102	5.90
AL113	2.20
ASY80	1.75
AU110	1.40
AY102	4.32
BA102	0.34
BA110	0.67
BA121	0.40
BA129	0.38
BA148	0.16
BA154	0.08
BA155	0.10
BA156	0.08
BA157	0.28
BA164	0.14
BB104B	0.52
BB105B	0.30
BB105G	0.48
BB110B	0.42
BC107	0.10
A or B	0.12
BC108	0.10
A,B or C	0.12
BC113	0.14
BC114	0.12
BC115	0.12
BC116	0.15
BC117	0.22
BC118	0.17
BC119	0.30
BC125	0.12
BC140	0.28
BC141	0.42
BC142	0.30
BC143	0.30
BC147	0.08
A or B	0.10
BC148	0.08
A or B	0.10
BC149	0.09
BC157	0.10
BC158	0.10
BC159	0.10
BC160	0.30
BC161	0.30
BC168B	0.12
BC169C	0.10
BC170	0.14
BC170B	0.12
BC171	0.10
BC171	0.10
A or B	0.08
BC172	0.08
A or B	0.12
BC177	0.20
BC178A	0.22
BC182	0.09
A,B or C	0.09
BC182L	0.09
A,B or C	0.09
BC183	0.09
A,B or C	0.10
BC183L	0.08
A,B or C	0.12
BC184L	0.10
A,B or C	0.10
BC207	0.15
BC208	0.16
BC212	0.09
A,B or C	0.10
BC212L	0.08
A,B or C	0.10
BC213	0.09
A or B	0.10
BC213L	0.10
A or B	0.10
BC237	0.11
BC238	0.12
BC239C	0.14
BC251	0.12
A,B or C	0.14
BC301	0.30
BC302	0.32
BC303	0.32
BC307	0.10
BC308A	0.10
BC323	0.99
BC327	0.14
BC328	0.14
BC337	0.12
BC338	0.12
BC350	0.14
BC440	0.30
BC441	0.32
BC461	0.32
BC547	0.12
BC548	0.12
BC549	0.12
BC550	0.18
BC550C	0.18
BC557	0.12
BC558	0.12
BCX34	0.27
BCY70	0.15
BCY71	0.17
BCY72	0.18
BCZ10	1.68
BCZ11	1.45
BD124P	0.80
BC130Y	0.68
BD131	0.34
BD132	0.34
BD131/BD132	0.95
BD135	0.32
BD136	0.36
BD137	0.36
BD138	0.38
BD139	0.38
BD140	0.38
BD144	1.60
BD145	1.82
BD150A	0.51
BD159	0.65
BD160	1.65
BD165	0.45
BD175	0.60
BD182	1.00
BD183	1.10
BD184	1.20
BD201	0.72
BD202	0.87
BD204	0.80
BD222	0.80
BD225	0.86
BD232	0.45
BD233	0.60
BD234	0.62
BD235	0.63
BD236	0.63
BD237	0.65
BD238	0.56
BD241	0.60
BD243A	0.80
BD244A	0.65
BD375	0.32
BD410	0.76
BD434	0.68
BD436	0.68
BD437	0.76
BD438	0.75
BD439	0.68
BD507	0.48
BD508	0.53
BD509	0.54
BD510	0.48
BD517	0.56
BD520	0.66
BD699	1.25
BD707	0.88
BDX18	2.35
BDX32	2.10
BF115	0.32
BF117	0.54
BF119	0.82
BF120	0.38
BF123	0.40
BF125	0.42
BF127	0.38
BF152	0.16
BF154	0.23
BF157	0.40
BF158	0.22
BF159	0.24
BF160	0.23
BF167	0.30
BF173	0.25
BF177	0.42
BF178	0.30
BF179	0.32
BF180	0.35
BF181	0.35
BF182	0.32
BF183	0.32
BF184	0.32
BF185	0.32
BF194	0.08
BF195	0.10
BF196	0.10
BF197	0.10
BF198	0.14
BF199	0.16
BF200	0.26
BF222	0.48
BF224	0.20
BF224J	0.16
BF240	0.20
BF241	0.20
BF244	0.26
BF244A	0.28
BF244C	0.24
BF245A	0.28
BF254	0.15
BF256	0.40
BF257	0.32
BF258	0.30
BF259	0.32
BF262	0.30
BF263	0.30
BF270	0.30
BF271	0.26
BF273	0.18
BF274	0.32
BF323	0.92
BF336	0.26
BF337	0.26
BF338	0.26
BF355	0.42
BF363	0.82
BF367	0.24
BF371	0.27
BF422	0.38
BF450	0.38
BF457	0.33
BF458	0.36
BF459	0.44
BFR39	0.22
BFR40	0.22
BFR41	0.22
BFR51	0.30
BFR61	0.32
BFR62	0.28
BFR88	0.34
BFR90	1.72
BFT41	0.38
BFT43	0.38
BFW10	0.79
BFW44	0.76
BFX29	0.28
BFX30	0.30
BFX80	3.56
BFX84	0.24
BFX85	0.26
BFX86	0.26
BFX87	0.26
BFX89	0.65
BFY50	0.21
BFY51	0.21
BFY52	0.21
BFY57	0.40
BFY90	0.90
BFY90S	1.34
BR100	0.20
BR101	0.44
BR103	0.58
BRC4443	1.76
BRY39	0.38
BRY56	0.42
BRY61	0.86
BSS17	0.56
BSS27	0.92
BSX19	0.34
BSX20	0.34
BSX59	0.62
BSX76	0.29
BT100A/02	0.94
BT101/300	1.15
BT101/500	1.25
BT102/300	1.35
BT102/500	1.65
BT106	1.50
BT108	1.30
BT109	1.18
BT116	1.25
BT119	3.62
BT120	3.60
BT121	3.02
BT138/600	1.30
BT151/560R	0.90
BT151/300R	1.15
BTY79/400R	2.80
BU100A	2.30
BU104	2.00
BU105	1.20
BU105/02	1.56
BU108	1.80
BU124	1.75
BU126	1.25
BU133	1.80
BU204	1.35
BU205	1.30
BU206	1.70
BU208	1.55
BU208A	1.63
BU208/02	2.05
BU326S	1.75
BU407	1.65
BU407D	1.80
BUX80	3.70
BUY20	1.75
BUY69A	2.60
BUY69B	1.98
BY101	0.48
BY118	1.10
BY122	0.68
BY126	0.12
BY127	0.10
BY133	0.16
BY135	0.25
BY164	0.44
BY179	0.66
BY182	0.87
BY184	0.40
BY187	0.72
BY189	4.75
BY198	0.44
BY199	0.47
BY206	0.24
BY207	0.24
BY210/400	0.25
BY210/600	0.26
BY210/800	0.30
BY223	1.20
BY227	0.26
BY229	0.30
BY238	0.68
BYX10	0.24
BYX36/150	0.22
BYX36/600	0.28
BYX48/300	0.72
BYX49/300	0.47
BYX55/350	0.29
BYX55/600	0.33
BYX71/600	1.18
BYZ12	0.42
C106D	0.80
E1222	0.40
E5024	0.30
GET872	0.48
ITT44	0.04
ITT2002	0.11
ME0402	0.20
ME0404/2	0.24
MEU21	0.60
MJ400	1.25
MJ2955	0.90
MJ3000	1.98
MJE240	0.60
MJE340	0.54
MJE370	0.88
MJE520	0.48
MJE2955	0.99
MJE3055	0.70
MPSLO1	0.28
OA47	0.10
OA90	0.08
OA91	0.09
OA95	0.18
OA200	0.06
OA202	0.15
OC25	2.10
OC26	1.70
OC28	1.50
OC29	2.47
OC35	1.75
OC36	1.75
OC42	0.72
OC42K	1.40
OC44	0.72
OC45	0.58
OC71	0.50
OC72	0.52
OC81	0.68
OC200	2.46
OC202	2.20
ORP12	0.85
R2008B	1.50
R2010B	1.52
SHG1 5	0.40
TAG1/100	1.40
TAG3/400	1.78
TIC44	0.40
TIC45	0.45
TIC46	0.48
TIC47	0.70
TIC106A	0.70
TIP30A	0.46
TIP31C	0.54
TIP32	0.40
TIP32C	0.60
TIP33A	0.63
TIP34A	0.72
TIP41C	0.46
TIP42A	0.52
TIP47	0.60
TIP110	0.88
TIP2955	0.60
TIP3055	0.60
TIS43	0.32
TIS88	0.40
TIS90	0.25
TIS91	0.28
ZTX108	0.12
ZTX109	0.12
ZTX212	0.28
IN4001	0.05
IN4003	0.05
IN4004	0.06
IN4006	0.07
IN4007	0.07
IN4148	0.05
IN5400	0.12
IN5402	0.15
IN5405	0.16
IN5406	0.18
IN5408	0.20
IS920	0.08
2N697	0.55
2N706A	0.33
2N2904	0.28
2N2906	0.24
2N2926G	0.10
2N3053	0.40
2N3054	0.56
2N3055	0.45
2N3702	0.10
2N3704	0.10
2N3708	0.10
2N3772	1.90
2N3773	2.70
2N3904	0.16
2N3906	0.16
2N5294	0.48
2N6107	0.71
2N6126	0.68
2SB337	1.60
2SC1172Y	2.90
2SC1173Y	0.82
2SC1302	1.40
2SC1226	0.84
2SC1279	0.50
2SC1306	0.92
2SC1307	1.40
2SC1413A	2.70
2SC1444	1.45
2AC1449	0.63
2SC1507	0.63
2SC1678	1.06
2SC1758	0.68
2SC1909	1.20
2SC1923	0.30
2SC1945	2.88
2SC1953	0.74
2SC1957	0.76
2SC1969	2.88
2SC2028	0.73
2SC2029	2.10
2SC2078	1.05
2SC2091	0.73
2SC2098	2.90
2SC2122A	3.20
2SC2166	1.20
2SC2314	0.80
2SC2335	1.50
2SC2749	2.70
2SC2752	0.60
2SD234	0.64
2SD348	3.30
2SD986	0.62
2SK134	3.80
2SK135	4.60
3N126	1.90
3N211	2.52
3SK45	0.76

CONVERGENCE POTENTIOMETERS

5, 7, 10, 15, 20, 50, 100, 200, 500W
38p each

SPECIAL OFFER

30, 120, 270, 470, all at **20p each**

CAPACITORS

Metallised Paper

2n2F 1500V DC	**60p**
2n2F 600V AC	**24p**
3n6F 1700V DC	**60p**
4n7F 1500V DC	**60p**
10nF 1000V DC	**22p**
10nF 500V AC	**80p**
15nF 300V AC	**30p**
22nF 300V AC	**32p**
100nF 1000V DC	**46p**
470nF 1000V DC	**85p**

HV Disc Ceramic (†)

1kV	1.5nF	**18p**
8kV	10, 47, 82, 100, 120, 150, 180, 200, 220pF	**30p**
	270, 300pF	**39p**

ZENER DIODES

400mW Plastic	3V–75V	**8p each**	**10/75p**
1 3W Plastic	3V–200V	**15p each**	**10/**
1 5W Flange	4 7–47V	**£1 40**	
2 5W Plastic	7 5–75V	**£1.26 each**	
20W Stud	7 5–75V	**87p each**	
		£1.31 each	

INTEGRATED CIRCUITS

Type	(£) EACH
AN240P	3.42
AN214Q	3.88
AN715Q	2.90
CA3065	1.75
CA4031P	2.88
CA4102	3.30
CA4250	3.50
CA4400	2.98
CA4422	3.07
LC7120	5.33
LC7130	5.26
LC7137	5.16
LM380N	1.65
LM1303N	2.52
HA1151P	3.12
MC1307P	1.85
MC1310P	1.85
MC1312P	2.25
MC1327P	1.25
MC1330P	0.83
MC1349P	1.85
MC1350P	1.20
MC1351P	2.50
MC1352P	1.50
MC1357P	2.88
MC1358P	1.30
MC1496L	1.15
ML231B	2.10
ML232B	2.10
ML237B	2.30
NE555	0.35
C-mos 555	0.88
NE556	0.80
SAA1024	5.35
SAA1025	8.40
SAS560A	2.50
SAS560S	1.85
SAS570S	1.85
SAS580	2.85
SAS590	2.82
SC9503P	1.10
SL432A	4.00
SL901B	5.20
SL917B	6.25
SL1327Q	1.10
SN76003N	2.44
SN76013N	1.90
SN76023ND	2.90
SN76033N	2.45
SN76110N	1.12
SN76115N	2.00
SN76131N	1.65
SN76226DN	1.80
SN76227N	1.10
SN76530P	1.40
SN76533N	1.60
SN76650N	1.05
SN76660N	0.75
SN76666N	0.80
STK015	6.50
TA7108P	3.20
TA7120P	2.20
TA7129AP	3.65
TA7130P	1.65
TA7172	1.80
TA7193	5.50
TA7172P	1.80
TA7176	2.50
TA7202P	4.18
TA7204P	1.86
TA7205AP	1.50
TA7208P	3.27
TA7210P	6.50
TA7222P	2.12
TA7223P	3.68
TA7227P	5.60
TA7310P	1.80
TAA263	2.46
TAA310A	2.68
TAA550	0.50
TAA570	1.99
TAA611A12	3.50
TAA630S	3.90
TAA661B	1.70
TAA700	2.80
TAA840	3.38
TAD100	2.80
FM FILTER	1.20
TBA120 AS,	
S,SA,SB	1.30
Q,T,U,UQ	1.32
TBA120B	1.30
TBA231	1.45
TBA281	2.65
TBA395	1.20
TBA480Q	1.50
TBA400	2.30
TBA510	2.60
TBA510Q	2.60
TBA520/Q	1.60
TBA530/Q	1.30
TBA540/Q	1.40
TBA550/Q	1.52
TBA560C	1.70
TBA560CQ	1.60
TBA570	1.50
TBA641BX1	4.50
TBA673	2.40
TBA700	2.85
TBA750	2.80
TBA800	1.60
TBA810P	1.10
TBA810S	1.20
TBA820	1.60
TBA890	3.88
TBA920/Q	3.00
TBA950/2A	3.05
TBA970	4.05
TBA990	1.88
TCA160C	3.90
TCA270S	4.00
TCA270SA	4.02
TCA800	3.10
TCA940	1.90
TDA440	3.80
TDA1002	1.90
TDA1003A	5.50
TDA1004A	3.75
TDA1006A	2.40
TDA1035S	4.50
TDA1044	4.30
TDA1170S	3.00
TDA1190	3.50
TDA1200	2.98
TDA1270Q	3.70
TDA1327A	1.66
TDA1352A/B	1.56
TDA1412	1.20
TDA2002	2.80
TDA2020	4.60
TDA2030	2.78
TDA2140	5.90
TDA2521	4.10
TDA2523	3.50
TDA2530	2.70
TDA2540	3.80
TDA2541	3.80
TDA2560	3.50
TDA2571A	2.50
TDA2581	3.20
TDA2590	3.20
TDA2591	2.98
TDA2593	2.98
TDA2610	3.20
TDA2611A	1.94
TDA2640	2.90
TDA2680	3.40
TDA2690	3.50
TDA3950A/B	2.60
UPC554C	1.32
UPC557H	0.90
UPC566H	2.95
UPC575C2	3.20
UPC1018C	1.10
UPC1025H	2.90
UPC1032H	0.90
UPC1156H	4.20
UPC1158H	0.76
UPC1163H	0.98
UPC1181H	1.60
UPC1185H2	3.75
UPC1212C	1.30
UPC1230H	3.90
UPC1350C	4.25
UPC1367C	3.40
UPC1378H	4.40
UPC2002H	2.80

SOLDERING SECTION

XS25W Iron kit, complete with stand & plug attached	7.20
CS18W as above	7.00
Antex 15W iron	5.00
Antex 18W iron	5.00
Antex 25W iron	5.20
Antex elements	2.00
Antex bits	0.95
Antex stands	1.90
Soldersucker	4.50
Spare nozzles for Soldersucker	0.65

SERVICE AIDS

ALL SERVISOL PRODUCTS

Switch Cleaner	0.88
Circuit Freezer	0.96
Foam Cleanser	0.84
Aero Klene	0.78
Silicone Grease (Aerosol)	1.00
Antistatic Spray	0.82
Plastic Seal	0.88
Excel Polish	0.76
Fire Extinguisher 640g	2.80
Video Head Cleaner	0.88
Silicone Grease (IC) 75g	1.00
Solda Mop (Std)	0.72
Solda Mop (L/Gauge)	0.72

Additional P&P on above 30p each

PRESETS

0.25W Type 100R-4m7 V&H 10p each, 0/90p
0.1W Type 100R-1M V&H 7p each, 10/65p

PLUGS & SOCKETS

- Metal Co-ax Plug
- Plastic Co-ax Plug
- Metal Line Socket
- Single Junction Socket
- Plastic Phono
- F M Plugs
- PL259 Plugs
- Reducer

Fuseholders

20mm Panel Mounting	0 28
20mm Chassis Mounting	0.06
1¼" Panel Mounting	0.35
1¼" Chassis Mounting	0.12
Carline 1¼" holder	0.10

TELEPHONE SPECIAL

B T App Telephone Plug + 3m Lead	£1 25
B T App Master Socket incl Wiring Instructions	£2.85
B T App Secondary Socket	£1 95

CHART RECORDER SPECIAL

Brand new 3 channel pen recorders complete with charts Full spec upon request once only price **£40 + £10 p&p + VAT**.

NI-CAD

Universal Ni-Cad Charger charges PP3,AA,C,D
Price **£5.00**

RECHARGEABLE BATTERIES

AA (HP7)	85ea.	10/75p.ea.
C (HP11)	1.75ea.	10/1 65 ea.
D (HP2)	2 05ea	10/1 95 ea.
PP3	3 80ea	10/3 70 ea.

I.C. SOCKETS

Dil to Dil

8 pin	0 08	0.70/10
14 pin	0.10	0.95/10
16 pin	0.11	1.00/10
18 pin	0.14	1.60/10
22 pin	0.21	1 95/10
24 pin	0.25	2.25/10
28 pin	0.30	2.75/10
40 pin	0.34	3 10/10

D. CONNECTORS

Male	9	15	25
SOLDER	.75	1.00	1.50
ANGLE	1.40	2.00	2.40
Female			
SOLDER	1.00	1.45	1.85
ANGLE	1.50	2.00	2.40
COVERS	.80	.80	.80

Potentiometers

Carbon Track, Rotary 0.25 W Log & Lin values. All ¼" Spindle, 20 ml body dia, Shaft 2' long.

4K7 – 2M2 Single Gang Log . . . . .32 10/£3.00
1K – 2M2 Single Gang Lin. . . . . .32 10/£3.00
5K – 2M2 Single Gang DP Switch Log . . . .75 10/£7.00
5K – 2M2 Double Gang Log & Lin . . . . . . .86 10/£8.25

Manufacturers please note – we can offer very competitive production quantities of 20 mm Q/Blow & T/Delay range – apply for quotation.

Type	Price
4000	24p
4001	24p
4002	25p
4007	25p
4011	24p
4012	24p
4013	56p
4014	60p
4015	60p
4016	40p
4017	60p
4018	60p
4020	85p
4021	58p
4022	96p
4023	35p
4024	50p
4025	24p
4027	45p
4028	45p
4029	75p
4030	35p
4031	1.30p
4033	1.25p
4034	1.46p
4035	70p
4036A	2.75p
4038	75p
4039A	2.80P
4040	60p
4042	50p
4043	42p
4044	50p
4046	60p
4049	38p
4050	36p
4051	70p
4052	60p
4053	60p
4066	45p
4067	2.45p
4068	24p
4069	24p
4070	25p
4071	24p
4072	25p
4073	25p
4075	25p
4076	68p
4077	25p
4078	25p
4081	25p
4082	25p
4085	58p
4086	58p
4089	1.25p
4093	37p
4094	95p
4095	95p
4096	99p
4097	2.65p
4098	80p
4099	1.05p
4161	96p
4162	96p
4163	96p
4174	96p
4175	1.00p
4194	99p
4501	38p
4502	38p
4503	40p
4507	48p
4508	1.30p
4510	55p
4511	55p
4512	55p
4513	55p
4514	1.15p
4515	1.15p
4516	55p
4517	2.70p
4518	48p
4520	53p
4521	1.15p
4522	1.25p
4526	60p
4528	68p
4531	1.30p
4532	65p
4536	2.65p
4538	80p
4539	90p
4541	90p
4543	1.25p
4549	4.00p
4553	2.45p
4554	1.92p
4555	35p
4556	55p
4557	2.50p
4558	1.20p
4559	3.25p
4560	1.80p
4562	3.50p
4566	1.75p
4569	1.95p
4583	1.05p
4584	55p
4585	70p
4724	1.10p

MICRO

2764-250n/s	£5.80
Z80A-CPU	£3.70
Z80A-CTC	£3.30
Z80-ADNA	9.00
Z80-AP10	3.40
Z80-AS10/0	8.75
Z80-AS10/2	8.99

VEROBOARD

0.1in.Clad.

2½ x 3¾"	85p
2½ x 5"	1.00
3¾ x 3¾"	1.05
3¾ x 5"	1.15
2½ x 17"	3.25
3¾ x 17"	4.10
4¾ x 17¾"	4.95
Pkt of 100 pins	.50
Spot face cutter	1.48
Pin insert.tool	1.83
Vero Wiring Pen + spool	3.50

VEROBOARD

0.1in.PLAIN.

3¾ x 5"	.95
3¾ x 17"	2.70
DIP Board	3.85
Vero Strip	1.25
HAND HELP CONTROL BOXES	.75

TERMINAL BLOCKS

2 amp 12 way	.19
5 amp 12 way	.20
15 amp 12 way	.46
32 amp 12 way	.92

RESISTORS – CARBON FILM 5%

¼W 1RO to 10M (E12 Range)	**2p each. 15p/10. 75p/100**
¼W 2R2 to 10M (E24 Range)	**2p each. 15p/10. 75p/100**
1W 10R to 2M2 (E12 Range)	**7p each. 65p/10. 6.00/100**
2W 10R to 2M2 (E6 Range)	**8p each 70p/10. 6.00/100**

RESISTOR KITS – each value individually packed

¼W pack 10 each value E12 – 10R to 1M 610 pieces	5.00
¼W pack 5 each value E12 – 10R to 1M 305 pieces	3.00
½W pack 10 each value E12 – 2R2 to 2M2 730 pieces	6.00
½W pack 5 each value E12 – 2R2 to 2M2 365 pieces	3.50
1W pack 5 each value E12 – 2R2 to 1M 353 pieces	15.00
2W pack 5 each value E6 – 10R to 2M2 317 pieces	18.00

RESISTORS – WIREWOUND. Generally 5%

2 5W – 0 22 to 270R – Available in preferred values	0.20
4W – 1R0 to 10K – Available in preferred values	0.21
7W – 0.47R to 22K – Available in preferred values	0.25
11W – 1R0 to 22K – Available in preferred values	0.29
17W –1R0 to 22K – Available in preferred values	0.37

FUSES Prices per 10

1¼" Quick Blow. 100, 150, 250mA **£1.30**. 1, 1.25, 1.5, 2, 2.5, 3, 10, 15A **55p. 1¼" Time Delay**. 100mA **£3.50**. 150mA **£2.25**. 250, 300, 500, 600, 750, 850mA **£1.84** 1, 1 25, 1 5, 1.6, 2A **£1.84**. 2.5A, 3.15, 3, 5A **£2.82**. **20mm Quick Blow** 100, 125, 160, 200, 250, 315, 400, 500, 630, 800mA, 1, 1 25, 1 6, 2, 2 5, 3 15, 4, 5, 6.3A. **40p. 20mm Time Delay**. 100, 125, 160, 200mA **£1.80**. 250, 315, 400, 500, 630, 800mA. **£1.00**. 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A **85p. 1" Mains**. 2, 3, 5, 7, 10, 13A **85p**.

MIN. "D" CONNECTORS.

		9way	15way	25way	37way
PLUGS	Solder Lug	.52	.65	.88	1.45
	R. Angle	.89	1.34	1.98	3.48
SOCKETS	Solder Lug	.78	.98	1.33	2.48
	R. Angle	1.18	1.78	2.70	4.15
COVERS		.95	.95	.98	1.00

EAST CORNWALL COMPONENTS,
DEPT. KK1
119 HIGH STREET,
WEM
SHREWSBURY SY4 5TT. TEL. 0939 32689 TELEX 35565

ORDERING: All components are brand new and to full specification. Please add 45p postage/packing (unless otherwise specified) to all orders and then add 15% VAT to the total. Either send cheque/cash/postal order or send/telephone your Access or Visa number. Official orders from schools, universities, colleges etc most welcome. (Do not forget to send for our 1984 catalogue – only 65p per copy – details at top of advertisement.) NEW RETAIL 1000 sq ft shop now open Mon-Fri 9.00-5.00. Sat 9-12.00

LINSLEY-HOOD CASSETTE RECORDER CIRCUITS

Complete record and replay circuits for very high quality low noise stereo cassette recorder. Circuits are optimised for our HS16 Super Quality Sendust Alloy Head. Switched bias and equalisation to cater for chrome and ferric tapes. Very easy to assemble on plug-in PCBs. Complete with full instructions.

Complete Stereo Record/Play Kit. £25.26
VU Meters to suit . . . . each £2.30
Reprints of original Articles . . . . no vat. 75p

STUART TAPE RECORDER CIRCUITS

Complete stereo record, replay and bias system for reel-to-reel recorders. These circuits will give studio quality with a good tape deck. Separate sections for record and replay give optimum performance and allow a third head monitoring system to be used where the deck has this fitted. Standard 250 mV input and output levels. Full details are in our lists.

Reprint of Original Articles . . . . no vat. £1.30

LINSLEY HOOD 300 SERIES AMPLIFIER KITS

Ultra high quality, Mosfet output, Hi-Fi amplifier kits by this famous designer. Two models of identical appearance are available, one giving 35 watts per channel output, the other 45. Careful design has made these amplifiers capable of superb sound quality. The delicacy and transparency of the tone quality enables them to outperform, on a side by side comparison, the majority of commercial amplifiers. Building is very easy as almost all components are fitted on easily removed printed circuit boards. Subsequent setting up needs only a simple multimeter to obtain the full specified performance. Both kits come with very comprehensive building instructions.

35 Watt Complete Kit **£79.50**
45 Watt Complete Kit **£83.50**
Reprints of Original Articles from 'Hi-Fi News' no Vat. £1

ALPS FF317U FM FRONT END

Beautiful, precision made High Quality variable capacitor tuned FM Front End with Dual-gate MosFet. The tuning capacitor also has 2-AM Gangs and built in 3:1 reduction gear. Covers full FM range of 87 to 109 MHz. Supply needed is 12 V at only 30 mA Max. Inputs are provided for AGC and AFC signals. These have recently been on special offer from another supplier at £4 plus vat **OUR PRICE IS ONLY £3.99 INCLUDING VAT AND POSTAGE!.** Circuit if required 35p

LINSLEY-HOOD 100-WATT MOSFET POWER AMPLIFIER

The very latest amplifier design, published in 'Wireless World' by the renowned John Linsley-Hood. This may now be taken as the standard by which the rest are judged! Our kit, approved by the designer, has massive heat sinks and power supply and includes all components needed to build. Case size 412 mm wide, 254 mm deep and 145 mm high. Automatic switched speaker protection is included as standard Cost of all parts over £120. Our complete stereo kit price **£105.50.**

COMPLETE STEREO TUNER MODULE

Three band LW/MW/FM Stereo Tuner fully assembled on PCB 165 x 85 mm. Supplied with Ferrite rod aerial and band switch fully wired. Facility provided to drive tuning meter and stereo LED. Only needs 12 V DC supply. FM sensitivity. 2.5 uV. **Price only £7.99 inc. Vat and post.**

DGS001 2-MOTOR, SOLENOID CONTROLLED CASSETTE DRIVE.

Fully solenoid controlled cassette mechanism suitable for Hi-Fi or digital use. With a logic control board the deck can be operated by lightweight touch controls or output from a micro. Ideal for applications under automatic control such as telephone answering machines, data loggers, automatic background music systems, remote control recorders and microcomputer program and data storage. Two motors and three solenoids control all functions including search in fast forward and rewind.
Standard fittings include reed switch for auto shut off, 3 digit counter, stereo R/P and erase Head.
Overall size 176 mm x 130 mm x 75 mm.
DGS001 Cassette Mechanism. **£37.25** Quantity prices on request.
INF140. Full technical specification and drawings **£1.**

AM VARICAP DIODE BARGAIN

Due to a fantastic bulk purchase we are now able to offer the super SMV2012 varicap diodes at unbelievable prices. These are a wide range diode for use in AM tuner applications. They are also supplied in matched sets to eliminate tracking errors! Matched pair only **25p.** Matched 4 only **60p.**
AM TUNER COIL SET Set of 4 coils for long medium and short wave AM tuner. Coils are LW Osc, MW Osc, SW Osc and SW Aerial. Normally 30p each. OUR PRICE FOR THE SET **ONLY 55p**
Application circuit using coils and matched pair of SMV2012 varicaps **35p**
Suitable PC Board **£1.50**
PC Mounting Wavechange Switch **£1.60**

HIGH QUALITY REPLACEMENT CASSETTE HEADS

Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard mountings make fitting easy and our TC1 Test Cassette helps you set the azimuth spot-on. We are the actual importers which means you get the benefit of lower prices for prime parts. Compare us with other suppliers and see! The following is a list of our most popular heads, all are suitable for use on Dolby machines and are ex-stock.

HC20 Permalloy Stereo Head. This is the standard head fitted as original equipment on most decks **£5.11**
HM90 High Beta Permalloy Head. A hard-wearing, higher performance head with metal capability **£8.06**
HS16 Sendust Alloy Super Head. the best head we can find. Longer life than Permalloy, higher output than Ferrite, fantastic frequency response **£9.91**
HQ551 4-Track Head for auto-reverse or quadrophonic use. Full specification record and playback head **£9.73**
Please consult our list for technical data on these and other Special Purpose Heads.

HART TRIPLE-PURPOSE TEST CASSETTE TC1

One inexpensive test cassette enables you to set up VU level head azimuth and tape speed. Invaluable when fitting new heads. Only **£4.66** plus VAT and 50p postage.

Tape Head De-magnetiser. Handy size mains operated unit prevents build up of residual head magnetisation causing noise on playback **£4.54**
Curved Pole Type for inaccessible heads **£4.85**

COMPONENTS

We now list a wide range of individual components many of which are not available elsewhere. Send for your copy of our latest list which also gives further information on our Kits.

Please add part cost of post, packing and insurance as follows:

INLAND
Orders up to £10 – 50p
Orders £10 to £49 – £1
Orders over £50 – £1.50

OVERSEAS
Please send sufficient to cover Surface or Air Post as required.

Personal callers are always very welcome but please note that we are closed all day Saturday

24 Hour Sales Line
(0691) 652894

PLEASE ADD VAT TO ALL PRICES

HART ELECTRONIC KITS LTD
PENYLAN MILL
OSWESTRY, SHROPSHIRE
SY10 9AF

What the competition hasn't been waiting for.

Latest version of Forth for the BBC (Is not rehashed Forth 79 Code)

Unique Stack Display Utility

16k Eprom type 27128

Multi-tasking operating system for Real-Time use.

Here's the Forth Eprom for the BBC Micro that makes all others out of date.

It's Multi-Forth 83 from David Husband who has built his reputation for Quality Forth products with his ZX81-Forth ROM, Spectrum Forth-I/O Cartridge and now New Multi-Forth 83 for the BBC Micro. This is not rehashed Forth 79 Code, but a completely new version of the Forth 83 Standard. It's unique in that it Multi-tasks, and therefore the user can have a number of Forth programs executing simultaneously and transparently of each other.

Multi-Forth 83 sits in the sideways ROM area of the BBC along with any other ROMs in use. It is compatible with the MOS, and specially vectored to enable a system to be reconfigured. It contains a Standard 6502 Assembler, a Standard Screen Editor, and a Unique Stack Display Utility.

With this Forth, David Husband has provided the BBC Micro with capabilities never before realised. And being 16K rather than 8K is twice the size of other versions. Multi-Forth 83 is supplied with an extensive Manual (170 pages plus) and at £45+VAT it is superb value.

Order it using the coupon adding £3.45 p&p (£6 for Europe, £12 outside) or if you want more information, tick that box instead. Either way, it will put you one step ahead of the competition.

Please send me Multi-Forth 83 for BBC Micro £45+VAT De-luxe System inc Disc £80+VAT
Cheques to Skywave Software Readers' A/C (or enter Visa No)

Please send me more information
☐ Multi-Forth 83
☐ ZX81-Forth ROM
☐ Spectrum Forth-I/O Cartridge

Name____________________
Address____________________
____
__________ Post code__________

SUBJECT TO AVAILABILITY. FOR I O O S ONWARDS
Send to Skywave Software, 73 Curzon Road, Bournemouth, BH1 4PW, Dorset, England Tel (0202) 302385

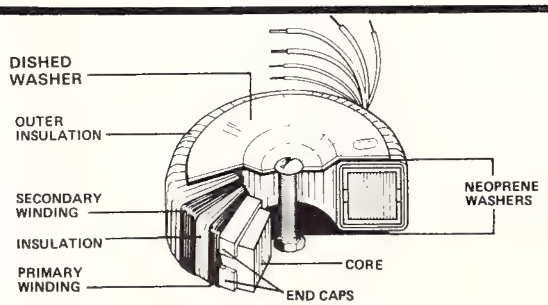
Skywave
SOFTWARE

MULTI-FORTH 83 FOR THE BBC MICRO

TOROIDALS

The toroidal transformer is now accepted as the standard in industry, overtaking the obsolete laminated type. Industry has been quick to recognise the advantages toroidals offer in size, weight, lower radiated field and, thanks to I.L.P., PRICE.

Our large standard range is complemented by our SPECIAL DESIGN section which can offer a prototype service within 14 DAYS together with a short lead time on quantity orders which can be programmed to your requirements with no price penalty.



15 VA
62 x 34mm 0.35Kg
Regulation 19%

SERIES No	SECONDARY Volts	RMS Current
0x010	6+6	1 25
0x011	9+9	0 83
0x012	12+12	0 63
0x013	15+15	0 50
0x014	18+18	0 42
0x015	22+22	0 34
0x016	25+25	0 30
0x017	30+30	0 25

(encased in ABS plastic)

30 VA
70 x 30mm 0.45Kg
Regulation 18%

1x010	6+6	2 50
1x011	9+9	1 66
1x012	12+12	1 25
1x013	15+15	1 00
1x014	18+18	0 83
1x015	22+22	0 68
1x016	25+25	0 60
1x017	30+30	0 50

50 VA
80 x 35mm 0.9Kg
Regulation 13%

2x010	6+6	4 16
2x011	9+9	2 77
2x012	12+12	2 08
2x013	15+15	1 66
2x014	18+18	1 38
2x015	22+22	1 13
2x016	25+25	1 00
2x017	30+30	0 83
2x028	110	0 45
2x029	220	0 22
2x030	240	0 20

80 VA
90 x 30mm 1Kg
Regulation 12%

3x010	6+6	6 64
3x011	9+9	4 44
3x012	12+12	3 33
3x013	15+15	2 66
3x014	18+18	2 22
3x015	22+22	1 81
3x016	25+25	1 60
3x017	30+30	1 33
3x028	110	0 72
3x029	220	0 36
3x030	240	0 33

120 VA
90 x 40mm 1.2Kg
Regulation 11%

4x010	6+6	10 00
4x011	9+9	6 66
4x012	12+12	5 00
4x013	15+15	4 00
4x014	18+18	3 33
4x015	22+22	2 72
4x016	25+25	2 40
4x017	30+30	2 00
4x018	35+35	1 71
4x028	110	1 09
4x029	220	0 54
4x030	240	0 50

160 VA
110 x 40mm 1.8Kg
Regulation 8%

5x011	9+9	8 89
5x012	12+12	6 66
5x013	15+15	5 33
5x014	18+18	4 44
5x015	22+22	3 63
5x016	25+25	3 20
5x017	30+30	2 66
5x018	35+35	2 28
5x026	40+40	2 00
5x028	110	1 45
5x029	220	0 72
5x030	240	0 66

225 VA
110 x 45mm 2.2Kg
Regulation 7%

6x012	12+12	9 38
6x013	15+15	7 50
6x014	18+18	6 25
6x015	22+22	5 11
6x016	25+25	4 50
6x017	30+30	3 75
6x018	35+35	3 21
6x026	40+40	2 81
6x025	45+45	2 50
6x033	50+50	2 25
6x028	110	2 04
6x029	220	1 02
6x030	240	0 93

300 VA
110 x 50mm 2.6Kg
Regulation 6%

7x013	15+15	10 00
7x014	18+18	8 33
7x015	22+22	6 82
7x016	25+25	6 00
7x017	30+30	5 00
7x018	35+35	4 28
7x026	40+40	3 75
7x025	45+45	3 33
7x033	50+50	3 00
7x028	110	2 72
7x029	220	1 36
7x030	240	1 25

500 VA
140 x 60mm 4Kg
Regulation 4%

8x016	25+25	10 00
8x017	30+30	8 33
8x018	35+35	7 14
8x026	40+40	6 25
8x025	45+45	5 55
8x033	50+50	5 00
8x042	55+55	4 54
8x028	110	4 54
8x029	220	2 27
8x030	240	2 08

625 VA
140 x 75mm 5Kg
Regulation 4%

9x017	30+30	10 41
9x018	35+35	8 92
9x026	40+40	7 81
9x025	45+45	6 94
9x033	50+50	6 25
9x042	55+55	5 68
9x028	110	5 68
9x029	220	2 84
9x030	240	2 60

Why a Toroid?

- * Smaller size & weight to meet modern 'slimline' requirements.
- * Low electrically induced noise demanded by compact equipment.
- * High efficiency enabling conservative rating whilst maintaining size advantages.
- * Lower operating temperature.

Why ILP?

- * Ex stock delivery for standard 240 V range
- * Fast prototype service available
- * 2 year no quibble guarantee
- * No price penalty for call-off orders

Prices including P & P and VAT

VA	Size	£	VA	Size	£
15	0	7.06	160	5	12.17
30	1	7.67	225	6	13.75
50	2	8.90	300	7	14.97
80	3	10.06	500	8	19.60
120	4	10.65	625	9	22.30

For 110V primary insert "O" in place of "X" in type number.
For 220V primary (Europe) insert "1" in place of "X" in type number.
For 240V primary (UK) insert "2" in place of "X" in type number.
IMPORTANT: Regulation - All voltages quoted are FULL LOAD.
Please add regulation figure to secondary voltage to obtain off load voltage.

Mail Order — Please make your crossed cheques or postal orders payable to ILP Electronics Ltd.

Trade — We will open your credit account immediately upon receipt of your first order.

BARCLAYCARD VISA

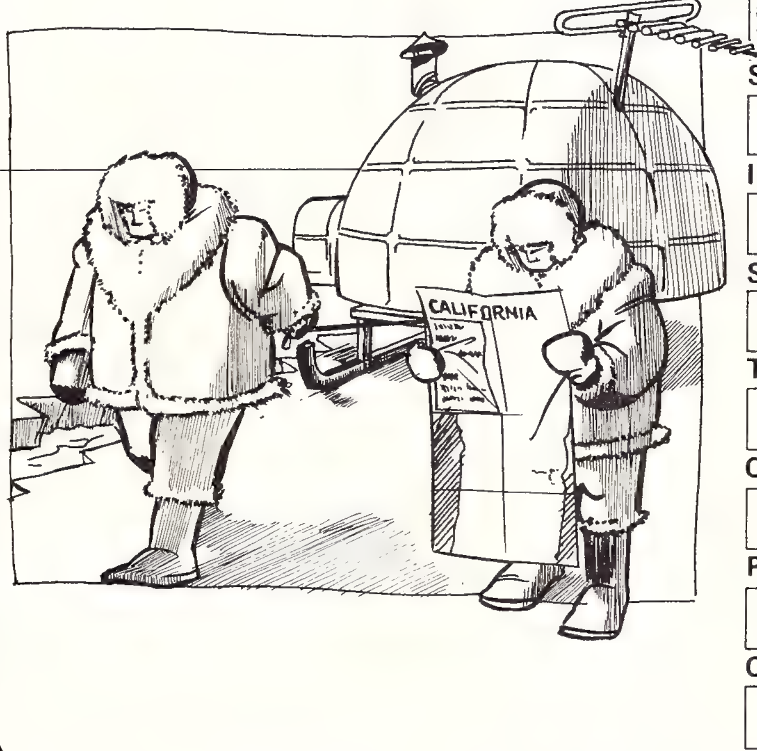
Post to: ILP Electronics Ltd., Dept. 4
Graham Bell House, Roper Close,
Canterbury, Kent. CT2 7EP
Tel: (0227) 454778 Telex: 965780

ILP ELECTRONICS LTD.

MOVING?

Mail to:
ELEKTOR PUBLISHERS., ELEKTOR HOUSE,
10 LONGPORT, CANTERBURY. CT1 1PE.

Please attach magazine label here, list new address below, and mail six to eight weeks before you move. If you are receiving duplicate copies of Elektor, please send both labels. Or if you have a question about your subscription attach label here and clip this form to your letter.



Surname

Initials

Street/Ave./Blvd.

Town

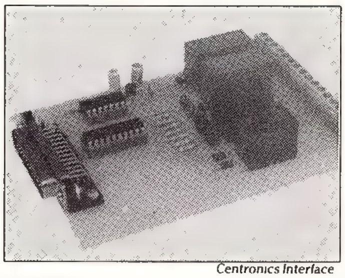
County/Province/State

Post code/Zip/Area code

Country

Cirkit. Making it bigger and better.

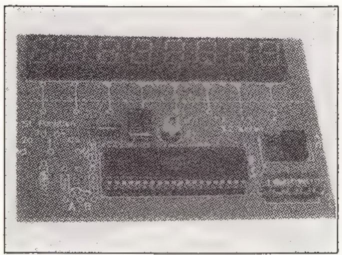
Cirkit stock all the components, accessories and tools and the kits you're looking for. Designed and selected to offer the best possible standards at the best possible price.



Centronics Interface

Cirkit Kits

CIRKIT ELECTRONICS TOOL KIT	Contains: 15W Soldering Iron 2 spare bits, heat shunt, solder, pliers, cutter, screwdriver	40-00007	15.56
AUDIO FUNCTION GENERATOR	Versatile waveform generator with sine, triangular and square wave outputs. On board mains PSU	41-01302	27.00
STEREO 40W AMPLIFIER	Single board 40W per channel stereo amplifier	41-01301	38.00
STEREO VU METER	5 LED per channel stereo VU meter for use with stereo amplifiers	41-01401	11.50
5W AUDIO AMP	A very compact audio output stage for use in a wide range of equipment	41-01406	4.60
UNIVERSAL AMP	A universal audio pre-amp with a gain of 10	41-01604	6.45
MONO REVERBERATION UNIT	Single channel, spring line reverb unit to add echo effects to tape recording etc.	41-01602	10.00
TONE GENERATOR AND DETECTOR	Very low distortion tone generator and signal detector for circuit fault finding	41-01603	10.45
10MHz DFM	8 Digit LED digital frequency meter and period measurement	41-01500	54.10
50MHz PRESCALER	Extend the range of the 10MHz DFM to 50MHz	41-01501	8.55
1-5MHz PRE AMP	Low frequency pre-amp and waveform shaper for the 10MHz DFM	41-01502	5.13
70cm PRE AMP	Low noise, miniature pre-amp for the 70cm amateur band	41-01506	4.78
70cm CONVERTER	70cm to 144MHz low noise converter featuring pre-aligned helical filter, schottky diode mixer and low noise transistors	41-01405	21.50
1-30V 1mA-2A PSU	Adjustable 1-30V Power supply with pre-setable current limit from 1mA-2A	41-01600	37.46
5-12V 1A PSU	Adjustable PSU from 5-12V with current protection, 1 amp max output	41-01504	6.45
1-30V 1.5A PSU	1-30 volt adjustable PSU with protected output up to 1.5 Amps	41-01402	10.45
3 DIGIT LED DVM	DVM to read up to 99.9 volts or configured as an ammeter to read up to 9.99 amps	41-01403	17.00
INFRA RED LINK	Single channel IR Link with relay output	41-01300	9.60
TEMPERATURE SENSOR	Thermistor based temperature sensor with relay output	41-01303	6.20
LOCOMOTIVE SOUND GENERATOR	Realistic steam sound and whistle for model railways	41-01304	9.20
LAMP DIMMER	Control lamps and drill speed	41-01305	5.70
WATER LEVEL ALARM	Alarm to indicate high water level or flooding	41-01601	2.70
3 NOTE CHIME	Doorbell chime with adjustable tones	41-01503	7.00
2M PRE AMP	Miniature low-noise MOSFET pre-amp for the 2m amateur band	41-01307	3.91
2M CONVERTER	Low noise 144MHz-28MHz amateur band converter	41-01306	17.35
2M POWER AMP	20W - 10dB gain - power amplifier for the 2m band. Automatic TX switch over, RX pre-amp, robust construction	41-01404	32.87

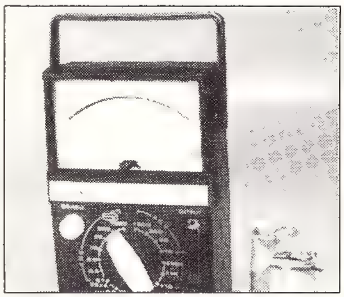


10MHz DFM

CRYSTAL CALIBRATOR	Crystal reference calibrator for alignment of receivers, outputs at 4, 2, 1MHZ, 100, 50 AND 10KHz	41-00801	4.32
CB NOISE SQUELCH	Improves to mute performance of the majority of CB rigs	41-01605	5.40
CENTRONICS INTERFACE	Connect your personal computer to the outside world via the Centronics printer output	41-01406	22.50
70cm PA	10W Power amp to boost the output of handheld and portable 70cm transceivers	41-01505	33.82

Selected Lines

BBC to Centronics Connect Cable		03-10019	7.25
Dragon to Centronics Connect Cable		03-10017	7.25
C12 Computer Cassette		21-00012	0.55
Interface 84 multiplexed Ram Card		40-84000	59.95
Z80A industrial controller		40-82000	54.95
EPROM Eraser 84T		40-82001	59.95
6502 Micro Controller		40-65020	54.95
6802 Micro Controller		40-68020	54.95
PB2720	80dB Piezo Buzzer	43-27201	0.55
10M15A	10.7 Center Freq.	20-10152	2.10
10M08AA	10.695 Center Freq.	20-11152	3.49
FC177	LCD (Freq.)	39-17700	20.00
CM161	LCD Clock	40-80161	8.25
8 x 0.3"	IC socket	28-00800	0.12
14 x 0.3"	IC socket	28-14000	0.13
16 x 0.3"	IC socket	28-16000	0.13
6V	KUIT-A Relay	46-80000	0.48
9V	KUIT-A Relay	46-80001	0.48
12V	KUIT-A Relay	46-80002	0.48
CX120P	COAX Relay	46-90120	11.96
CX520D	COAX Relay	46-90520	26.98
CX540D	COAX Relay (BNC)	46-90540	26.98



HT-320
Multimeter (20kΩ-V) 56-83201 14.00

Please add 15% VAT to all advertised prices and 60p post and packing. Minimum order value £5 please. We reserve the right to vary prices in accordance with market fluctuation.
Just send for our catalogue or visit one of our three outlets at:

200 North Service Road, Brentwood, Essex CM14 4SG,
53 Burrfields Road, Portsmouth, Hampshire. PO3 5EB;
Park Lane, Broxbourne, Hertfordshire. EN10 7NQ

To: Cirkit Holdings PLC, Park Lane,
Broxbourne, Hertfordshire. EN10 7NQ.

I enclose 85p. Please send me your latest catalogue and 3 x £1 discount vouchers!
If you have any enquiries please telephone us on Hoddesdon (0992) 444111.

Name ______________________

Address ______________________

____

Telephone ______________________

Area of Special Interest ______________________

Cirkit
Bigger Stock. Better Service

E/1

NEW WINTER CATALOGUE OUT NOW!

Spectrum no spectre

Sinclair's new computer, the Spectrum Plus, which was launched last autumn as a positive reaction to the market (which had demanded a new keyboard), is being manufactured by Timex in Scotland, A B Electronics in Wales, and Samsung Electronics in South Korea. Total production capacity for the Spectrum and Spectrum Plus is 200 000 models per month.

Although Sinclair intends to continue selling its basic £130 Spectrum model (the basic Plus retails at £180), it forecast that the Spectrum Plus will achieve double its forerunner's UK sales. Last year the Spectrum yielded pre-tax profits of £14 million on its turnover of £77.7 million.

Sinclair is also stepping up production of its more expensive QL to 30 000 units a month, which may necessitate the appointment of one or more additional sub-contractors. (LPS)

Aid for the unsighted

A microcomputer system that converts braille into print to help blind people at school or work has won an award, presented by the BBC for the best invention to help the unsighted. The winner is Dr Tom Vincent, a physics lecturer, for his development of the Work Station, which enables a person to type in braille, produce a simultaneous printed version, and then, with the help of a voice synthesizer, to check the print version independently.

Dr Vincent has also devised ancillary software, which enables a blind person to make use of word processing facilities, and keep personal braille records on floppy disks.

The system has been tested for over a year in a number of UK schools and was demonstrated recently at the BBC's London Headquarters by 16-year old Wendy Kirton, a Welsh schoolgirl who has been blind from birth.

Dr Vincent is currently seeking commercial backing for the entire synthesizer and personal records concept, because he believes that it 'has great world-wide export potential. Almost any language can be incorporated'. The basic software for the concept costs about £1000 to set up. Existing brand-name hardware could be adapted for a similar sum. (LPS)

Your rights and British Telecom

A booklet published recently explains to British Telecom's customers the service British Telecom provides and gives advice on what to do if things go wrong.

The Consumer Code for British Telecommunications PLC has been produced to reflect changes in the legal relationship between British Telecom and its customers and is a requirement of British Telecom's licence.

In addition to their normal legal rights, customers with grievances can still choose independent arbitration to resolve small claims. The recommendations of the arbitrator are legally binding on both parties. Detailed advice is given in the new code.

A copy of the code is available on request from any British Telecom local office, as well as from Citizens Advice Bureaux. The text of the code is also to be printed in all new telephone directories.

ANZCAN replaces COMPAC

The £250 million trans-Pacific link, in which British Telecom International (BTI) has a significant share, and which was inaugurated by HM The Queen in London recently, is one of the worlds longest undersea telecommunications cables. Named ANZCAN, the cable runs more that 15 000 km (8100 nautical miles) between Australia, New Zealand, Fiji, Hawaii, and Canada. It was largely designed and made in Britain. It can carry 1380 simultaneous telephone calls on the major route between Canada and Australia, and its capacity is nearly twenty times larger than the COMPAC cable it replaces.

The cable's landing points are at Sydney, Takapuna (near Auckland), Norfolk Island, Fiji, Oahu Island (Hawaii), and Port Alberni (Vancouver Island). It is linked to western Europe by a microwave system across Canada and then through the Cantat 2 transatlantic cable to England.

The cable's major route, from Sydney to Port Alberni, utilizes the STC 14 MHz system which provides 1380 circuits of 4 kHz bandwidth. It includes more than 1100 undersea repeaters and equalizers, spliced into the cable at 13 km intervals.

Nearly 14 000 km of the cable were made in Britain by Standard Telephones and Cables. ANZCAN was laid by Cable & Wireless cable ships. More than five million phone calls are made every year between the UK and Australia and New Zealand.

Telecom Gold on high seas

Direct access to Telecom Gold's electronic mail service is now available to ships operating worldwide. This high seas extension of Telecom Gold has been made possible through British Telecom International's INMARSAT maritime satellite communication service.

With suitable on-board computer equipment and the adaptation of the satellite communications terminal (the ship's earth station), an authorized Telecom Gold customer can access the full range of Gold features from any part of the world.

The new service to shipping is identical to that already offered by Telecom Gold to customers in the UK. These users link their microcomputer (or other communicating terminal) to telephone modems or acoustic couplers to send data and information to other terminals over the ordinary telephone network or through British Telecom's Packet Switchstream data service.

Telecom Gold's incoming and outgoing telex facility enables UK-based telex machines to send and receive messages from all shipping using Gold's electronic mail service.

Seconds out! Round two!

British Olivetti Limited has hired Wickes Associates International Ltd (WAI), a leading public relations consultancy specializing in the computer and related technologies industry, to handle press relations for the company's range of IBM PC compatible and portable microcomputers.

WAI's prime task is to support a major new marketing campaign in which Olivetti's M21 and M24 micros will compete aggressively against the IBM PC.

According to a spokesman for WAI: 'Olivetti has no option but to go for the throat. IBM's dominance of the PC market has little to do with technology and lots to do with marketing. One look at the products and you can see that Olivetti has won any technical battle hands-down. Now it's 'gloves off' in the marketing arena'.

SCOTs for the Navy

The UK Ministry of Defence has awarded the Satellite Communications Division of Marconi Defence Systems Limited of Stanmore, Middlesex, the largest single contract ever placed with a European company for satellite communications terminals. The order covers the supply of nineteen Enhanced Shipborne Communications Terminals (SCOT) to the Royal Navy.

SCOT 1, the world's first and only lightweight operational SHF shipborne terminal, revolutionized naval communications planning in the early 1970s by offering an immediate and secure long-distance satellite link that matched the quality and reliability hitherto only obtainable from terrestrial line-of-sight equipment. Various versions of SCOT 1 have now served as the RN's primary long-haul satellite communications equipment for over ten years.

Enhanced SCOT, the latest version, exploits the company's unrivalled base of experience by providing even higher availability and full interoperability with all current and planned US, NATO, and UK military communications satellites. A modular design allows the terminal to be offered in a number of variants, tailored to different classes of ship, ship fitting concepts, and operational requirements. Speech, telegraph, data, and facsimile transmission are all accomodated.

21st Century Technology

As part of the celebrations to mark the centenary of City and Guilds College, the engineering faculty of Imperial College of Science and Technology, London University, a symposium titled 21st Century Technology is to be held on 27 February 1985.

The College has chosen as the overall theme for the celebration 'Engineering for Wealth' to emphasize the enormous contribution that engineers have made to the wealth of the country since the first students entered the College in 1885.

The centenary celebrations will also include an exhibition entitled Technology 2000, which will show many of the most recent technical developments at the College, with particular emphasis on the links with industry.

The symposium will examine the implications and opportunities for industry, education, and employment presented by the technology currently being developed and the role of the engineer will continue to play in wealth creation.

Among the many speakers, Igor Aleksander, Kobler Professor in Management of Information Technology, will argue that evolutionary pressures underlying the booming multi-million dollar information technology markets demand that machines should become much more sensitive to natural modes of communication between people.

IDD augmentation

British Telecom International, which is responsible for providing telecommunications services to 217 countries worldwide, as well as to ships at sea and oil and gas production platforms in the North Sea, through a network of satellite, submarine cable, and microwave systems, has reached agreement with GTE Sprint of Burlingame, California, and MCI International, also of the USA, to operate a both-way telephone service between the UK and the USA.

The opening date for service will depend on the successful completion of engineering tests.

At present, BTI's international direct dialling (IDD) service to the USA is provided exclusively with AT&T Communications. BTI's IDD service reaches 161 countries throughout the world and this number is growing constantly. IDD service is available to all British Telecom customers in the UK, and ninety-seven per cent of international telephone calls from the UK are dialled direct by customers.

Automating the automators

Manufacturers of semiconductor devices that lie at the heart of the computer revolution are themselves about to undergo a wave of automation. In particular, cost pressures from heavily automated Japanese producers and the need for more vigorous quality control is focussing management attention on the making of wafers, the sheets of semiconductor material on which integrated-circuit patterns are engraved.

According to a new Frost & Sullivan study 'The Automated Semiconductor Wafer Fabrication Market in the U.S.' (#1296), spending on the hardware and software that controls the accuracy of wafer production and its movement through the factory will jump an average of thirty per cent a year through 1993 to $1100 million from a projected $83 million this year.

Towards a paperless office

A major breakthrough in computerized filling and reproduction of most types of industrial and commercial paperwork has been introduced by Norwegian electronics specialist Eldak A/S.

At the heart of the Document Management System is a Digscan 9100 digital scanner, developed for the US aerial and space reconnaissance technology. This unit optically reads every kind of document, drawing, map, or photograph up to A0 size and transfers the data in digital form to an E100D terminal for viewing, storage manipulation, or modification. Depending on user requirements, the terminal can be connected to disk and magnetic storage, electrostatic plotter, internal or external networks, and modems for communication or electronic mail.

Apart from offering a complete solution for a company's total paper flow, the DMS concept can also be readily interfaced with existing computer-based systems.

Auto electronics comes of age

The next time you see a truck and trailer combination halted on the hard shoulder of the motorway, its cluster of hazard warning lights flashing away, the chances are that this vital safety equipment was designed and produced by Thomas Electronics International Limited of Birch Vale near Stockport.

This company was founded in 1963 and had on its 21st anniversary grown to a staff of fifty with a turnover of more than a million pounds.

If the direction indicators on a Mini fail, the driver can continue on his way using hand signals. When the flashers fail on a heavy goods vehicle, it is illegal for it to proceed further. It must stop until the lights are repaired and this, of course, is very expensive in terms of lost business. To minimize the risk of such expensive stoppages, Thomas developed the Teltester which checks the entire electrical system of a truck in

15 minutes as compared with 15 hours by conventional means. The Teltester, which was featured on BBC's *Tomorrow's World* as an example of advanced technology, not only locates existing faults but also warns of impending faults.

Electronic box office

One of London's leading ticket agencies, Edwards and Edwards, recently launched a national theatre booking service on British Telecom's Prestel network. A wide variety of information on a range of entertainments is now available, along with the time-saving facility to book and pay for tickets from the comfort of home. At its launch, the electronic box office opened with details of fifty-two different productions ranging from comedy to opera and covering major theatres in London, Stratford upon Avon, and New York.

Prestel works through ordinary telephone lines and offers local call access to ninety-six per cent of UK telephone users. It is already being used for home-shopping, banking from home, travel agency bookings, advertising residential properties, and providing up-to-the-minute information on stock exchange prices, currency markets, and horse racing. In addition, there are many popular general information services including news, current affaires, sport, weather, and finance.

LaserJet hits the market

After the introduction by Epson early last autumn of the LQ1500 laser printer, Electronic Printing Systems have launched the LaserJet. This printer is being manufactured by Hewlett Packard, but EPS have been selected to market the product due to their specialist experience in the laser market and their expertise on interface development to suit a wide range of hardware.

Although these printers currently cost thousands of pounds, Micro Peripherals of Basingstoke forecast that prices are likely to fall steeply and that in about twelve months' time there will be a laser printer on the market at under £1000.

Laser printers can operate at some 180 characters per second and provide features such as variable typeface with the ability to mix up to four different fonts on a single page, the printing of charts, graphs, grid lines, raster graphics, and even digitized logos and signatures. And laser printers are absolutely silent!

Vodafone on target

Details of the coverage Racal-Vodafone is planning for its new mobile and portable public radiotelephone service in the North of England and Scotland published recently show the rapid expansion of the Vodafone network throughout the UK covering the major centres of population, motorways, and main trunk roads. The Vodafone service will be available to seventy per cent of the UK population within two years and, as the 25-year cellular radio licence stipulates, will cover ninety per cent of the population by 1989.

As the Vodafone service is progressing on schedule, trials commenced in Central London during December as planned. Once the trials have been completed satisfactorily, the Vodafone network will open for public service early this year.

Light under the Solent

The world's first undersea single-mode lightline — a £600 000 optical fibre cable — has been successfully laid by British Telecom. The cable, which is part of Telecom's huge investment to provide customers with modern digital services throughout the UK, will carry telephone calls and data across the Solent as pulses of laser light.

The 23 km long cable, linking Portsmouth and Ryde, contains four pairs of fibres. Each fibre pair works at 140 Mbit/s — a capacity of nearly 2000 telephone calls at once, or the equivalent in data or other services. The system will use long-wavelength (1300 nm) single-mode transmission, enabling light pulses to travel the entire 23 km length of the cable without intermediate amplification. Typically, optical fibre cables are ten times lighter and thinner than conventional copper coaxial inter-city telephone cables.

Single-mode transmission has particular economic and operating advantages:

- on land networks, it will allow the light amplifiers, known as regenerators, to be always housed in buildings instead of roadside manholes, making access easier and maintenance cheaper;
- in submarine systems, it will allow regenerators to be spaced at 30...50 km intervals, compared with the current undersea coaxial cable links where amplifiers are needed every 5 km or so — this provides significant circuit cost savings.

The Solent crossing, though the first under the sea, is not British Telecom's first underwater Lightline. In Wales, 1.7 km of optical fibre cable crosses a lake between Tywyn and Corris, and the Barrow to Millom route crosses the Duddon estuary.

Fortune keeps smiling on Scotland

Three major expansion plans for Scottish electronics plants have been announced: Honeywell Information Systems is to increase output from its Newhouse plant by thirty per cent early this year; Hewlett Packard is to expand its facility at South Queensgate with a £12 million programme; and Apollo Computer Inc. are to open a major new European facility in Livingston.

Honeywell has been involved in electronics operations in Scotland for 21 years. The last two years have seen a £1.5 million modernization scheme (including a £700 000 functional board tester) which has improved the working environment.

Principal products from Newhouse are DPS8 large-scale systems and DPS6 business micros, but the company foresees a strong growth in the add-on business in line with the market's demand for extra memory and processing power.

Hewlett Packard's investment plans were revealed when the company opened a new £7 million expansion which has already increased the facility from 18 600 m^2 to 27 900 m^2. Under the proposed plan, £12 million will be spent in adding a further 9300 m^2 at South Queensferry. The decision to move straight into further expansion is a response to increasing demand for microwave and telecommunications equipment of the type produced by the plant. The development should be completed early next year.

Hewlett Packard announced at the same time that it had been awarded a £2.8 million contract by British Telecom for its remote-access test equipment system. This follows an earlier £3 million order for the equipment, delivery of which has just been completed.

Apollo Computer are opening a 3200 m² building which will house training, sales and service, and a Pan-European logistics repair depot. In the longer term the company intends to set up a manufacturing centre.

Apollo Computer Inc. is the world's fastest growing manufacturer of professional workstations for engineering and scientific applications. Its DOMAIN workstations have been accepted as the industry standard for computer-aided engineering (CAE), design (CAD), and software development applications (CASD). (LPS)

People

Mr D R Morse, C. Eng, FIEE, Chief Engineer, External Relations (Engineering Division), retired from the BBC in November last after 37 years' service.

Mr C Bull has been appointed to the new British Telecom headquarters post of Corporate Treasurer.

Mr D E Fielding has been appointed Director of Operations, British Telecom Enterprises (BTE). He will continue as Finance Director, BTE, a position he has held since 1982.

Mr N Cave has been appointed Director and General Manager of Dowty Circuits, a division of Dowty Electronics.

Following last summer's reorganization of the Marconi Group of Companies, Mr D Fletcher has been appointed managing director of the new company Marconi Defence Systems Limited. The new company has already been hailed as 'the flagship of Europe's most powerful defence electronics organization'.

Silicon-on-sapphire in Lincoln

As a further stage in the company's commitment to investment in leading edge technology, Marconi is to establish a Silicon Systems Laboratory in Lincoln. The laboratory will provide advanced processing facilities for 1.5 micron silicon-on-sapphire (SOS) technology. It will be fully equipped for direct step on wafer photo-lithography, dry etching, and dedicated furnace processing, together with the associated process control equipment. The high-current ion implantation equipment recently installed in the adjacent MEDL IC fabrication area will be available for SOS processing to provide a complete facility for the 1.5 micron technology.

The advantages of SOS as an enhanced CMOS technology are improved speed or reduced power combined with a high logic packing density and proven radiation resistance. The technology is suitable for all applications where power consumption and heat dissipation must be minimized whilst still achieving very high logic throughput rates. A particularly important application is for electronics in satellites where the cost of providing electrical power is high and the electronic circuits are exposed to many years of continuous natural radiation.

Balancing act resolved

Problems of connecting a receiving or transmitting balanced aerial to an unbalanced radio receiver or transmitter with coaxial cable or other unbalanced transmission line have been solved at Exeter University.

According to Mr P May, senior lecturer at the university's Department of Science Engineering, the various devices such as transformers and coaxial transmission line baluns which have been used so far to overcome the problems are often inefficient and, in the case of transmitting aerials, there is also a serious heat dissipation problem.

Mr May's solution, which has been patented, is to produce a balanced aerial with an active element to an unbalanced transmission line with two conductors. The basic principle advocated is that the coaxial cable should enter the aerial system inside an earth plane, the zero potential surface of the aerial. The path of the coaxial cable should only be allowed out of this zero potential plane if it forms an integral part of an element of the aerial system.

When this principle is applied to a Yagi aerial, the coaxial cable forms a simple loop which is, in fact, half of the folded dipole in the Yagi array. The technique can be used with double or triple-folded dipoles, half-wave folded dipoles, full wave or two-third-wave dipoles, and in wide bandwidth applications. (LPS)

British computer for Swiss newspapers

Swiss newspaper publisher Gasser AG, who publish several German-language newspapers, including the daily *Bunder Zeitung*, have ordered a £330 000 CS7-15 Series 2 editorial text management and typesetting system from Ferranti Computer Systems.

The equipment includes six Argus 700GL processors with 4 Mbytes of main memory, two 160 Mbyte Winchester disks, twenty-nine VDUs, two page make-up terminals, four printers, system control consoles, and the latest multiprocessor operating system.

Direct input of the wire service provided by the Schweizerische Depeschenagentur (SDA) provides a round the clock supply of world-wide news. This is stored in CS7's magnetic disk memory which can be edited as required on VDU terminals.

In common with many newspaper publishers in Europe, Gasser have an active general printing requirement and the extensive page make-up, tabulation, and automatic pagination facilities of CS7 are of particular value for those areas. (LPS)

Events

Electronic Displays '84 Exhibition and Conference
28. . . 30 November 1984
Kensington Exhibition Centre, London

Cellular Radio National Conference
7. . . 8 February 1985
Marriott Hotel, London

Defence Components & Equipment Exhibition and Conference
14. . . 16 May 1985
Metropole Hotel, Brighton

POWER 85 Exhibition and Conference
21. . . 23 May 1985
Metropole Hotel, Brighton

COMPETA '85 (computers & peripherals) Exhibition and conference
4. . . 6 June 1985
Kensington Exhibition Centre, London

Euromicro 85 Symposium on microprocessing and programming
3. . . 6 September 1985
Brussels

tea leaves . . .

Looking in our tea cups, we did not feel like starting the new year with reflections on super-chips or solid-state audio, but decided to wait and see how last year's tea-leaf patterns in this respect will fare.

So, what would we like to muse over? Well, the first point is the state of technological development. This is still accelerating at an increasing rate: the super-chip of today is the standard chip of tomorrow. We regularly receive letters with cries for help like: "Help! I stopped my subscription two years ago, but because of withdrawal symptoms I have recently recommenced it. But I don't understand the circuits any more!. . ."

If we give free rein to our gaze into the future, we must assume that intelligent machines, far-reaching miniaturization, and affordable prices will become the norm.

The second point is: where will we find ourselves in 1985? One thing is certain: new devices and equipment no longer amaze us. The housewife will have a microprocessor-controlled microwave oven which automatically weighs the food and sets the appropriate temperature. All she has to do is to indicate that she is putting in a chicken and the oven does the rest. Or does it? The first time the oven is being used, you hear cries from the kitchen "Why is that stupid thing not working? It is program three. . .chicken. . . well then, why don't you start? Oh, the door was not closed properly. Sorry!" Click.

So, we are no longer overwhelmed with wonder, but we do remain critical. If a 'stupid thing' does not do what we expect it to do, it's no fun any longer.

Utensils and crazes

When something is new and not too expensive, it sells. With some luck (and a lot of publicity) it may become a craze. Or a fashion. Or a normal utensil for everyday use. What's the difference?

Why were newton's marbles, the hula hoop, and the rubik cube crazes? Why were the charleston, the mini skirt, and aluminium luggage racks in fashion? Why are telephones, automatic washing machines, and zips utensils? The difference appears to lie in the user-friendliness. Utensils are just, well, handy. They make it possible to do something you wanted to do in an easy manner. They have a purpose, they meet a need. Crazes and fashions are, initially, exciting, but after a while the novelty wears off — and all of a sudden they are no longer useful, or user-friendly; just plain dull.

Which brings us to the home computer. Craze or utensil? As they are now, we would say: craze. They are affordable, exciting — even addictive. If you manage to work with them you continue doing so. Sometimes until two or three in the morning. But why? And here's the crux of the matter. Because those 'stupid things' do not understand — and therefore don't do — what you want. They are not user-friendly. And that's why most computer owners get fed up with their machines. The standard games are boring and the 'family memory' was far more accessible when it was contained in the telephone book. Home programming is not so hot either. So?

In nine out of ten cases, the computer is put away in a cupboard. Nice when you have visitors, but for the rest... In the remaining one case, some interest remains. Elektor readers are prominent here. They want more. For them the computer is a hobby, not a utensil. For that, it is not yet sufficiently user-friendly.

The future

Back to the tea leaves. What can we expect? Which crazes will come and go? What utensils will come and become 'normal'?

As we said, the cheap home computer appears to have all the hallmarks of a craze. The new MSX sets promise to become one hell of a craze: they are almost 'real', there are promises of much software, and they are not too expensive.

But...user-friendly? No, not really. Do they meet a real need? No, not really.

What about that pocket-diary-in-a-wristwatch recently launched by Seiko? There is some doubt here. An 'old-fashioned' diary is cheap and convenient, and you can enter or alter information in it without first having to read the operating instructions. And yet, a watch is always with you, while a diary may accidentally be left at home.

What are our real needs; in what direction should we look for future utensils? Let's see:

- **Peace and quiet**. A noise eradicator would be very desirable. Built into your easy chair, or at the head-end of your bed. Technically, it is quite feasible, but as yet very expensive.
- **Communication**, but selective. This is a wide field, but to name one aspect that is definitely technically possible: a new British Telecom telephone service. John indicates on his phone that he would like to speak to his brother. All subscribers indicate when they don't want to be disturbed; for instance, by a switch on their phone. On the first occasion both John and his brother are free and available, the computer makes the connection.
- **Information**. Assuming that you're interested in international news, chess, cartoons, and technical news, which paper do you read? Why, your own, personalized one, of course — ordered from a fully automated publishing company. Each morning your very own paper rolls from your own printer — no sports results, no stock exchange news, no gossip.
- **Literature**: books and magazines, for relaxation or learning. Currently, these have many advantages: they are easy to use, legible, and relatively cheap. A computer screen is definitely not an improvement! And yet, the electronic system has its good points: the information is distributed easily and cheaply, and the 'covers' may be very compact — mini cassette or mini floppy. So, what do we need? A handy, not too expensive, battery-operated reading book with a clearly legible screen. Put in the cassette and on you go with your novel. When you've finished it, you call for a new 'book' — by telephone, of course! Now, that will be user-friendly!
- **Physical aids**, for healthy as well as for (lightly) handicapped people. Better hearing aids, for example, but also night glasses (with light amplifier), which are much more convenient and economical than torches. Or a muscle-enervating massage belt to enable you to lose those pounds during breakfast — now, that could become a craze (and, like its current mechanical counterpart, it would be quite useless!).
- **Elektor**. What sort of articles will we publish in *Elektor* in the 1990s? Using the same criteria as today — practice-oriented, using modern technology, broadly dealing with all aspects of electronics — the contents are bound to be quite different. Or are they?

We will publish audio preamplifiers, but with a 32-way input bus for those new audio ROMs.

And we will combine those new Mbyte memory ICs with those ridiculously cheap A/D and D/A converters to make a guaranteed-reproducible echo unit.

We will make a de luxe house telephone exchange for connection to the normal telephone network: this will be allowed by then.

We will make a 'music searcher' which tunes the radio (yes, that will still exist) to a transmitter that broadcasts the music of our liking and no advertising!

We will...well, we'll see... In any case, we'll make it interesting!

selektor

computers of the future

It is not all that long ago that computers worked only from a bunch of punched cards which could not be produced at home. Nowadays, computers are generally operated from a keyboard but this is still a long way from the desired goal of voice-actuated machines. Keyboards are highly restrictive because they mean that if a user wants to communicate with a computer he or she has to learn to write programs. As the main uses of computers will become centred more and more on office automation, data communications, and home work stations, it is extremely unlikely that more than a small proportion of users will be prepared to learn how to program — and why should they?

No, computers will have to come into much closer contact with the user to become a real tool of human thought. This means that computers have to become much cleverer than they are.

In essence, a computer is nothing but an array of interfacing units: at the centre the microprocessor, swathed in software — machine code, compilers, assemblers, operating systems, languages, application programs, printers and/or screens. This is, of course, an unfortunate arrangement because any change at the user's end will normally affect all these peripherals, and therefore the very design of the computer.

Of course, even users of personal computers now have other devices at their disposal for communicating with the computer. For example, the mouse is a small pointing device which when rolled along a desktop causes a pointer to move across the screen in a corresponding direction. Originally the mouse was operated through a pair of wires, but modern versions are cordless and communicate with the computer by infrared signals. The mouse is also used to select icons, which are small graphic representations displayed on the screen to illustrate a computer function.

These are but first steps towards personalization of the computer, that is, giving the user facilities for moulding the operations more to his own requirements. The next steps will probably have to wait until the 32-bit microprocessors (such as Motorola's 68020S, Intel's 80386, Zilog's Z8000, or National Semiconductor's NS32032) and very large, inexpensive memories have become available in the course of the next few years. It is true, of course, that there are 32-bit computers on the market already, such as Apple's Lisa and MacIntosh, both of which use Motorola's 68000 microprocessor. Unfortunately, the 68000 has only a 16-bit bus, so to the user these computers do not seem much faster than IBM's 16-bit PC. True 32-bit chips with a full-size bus will enable designers of PCs to give users much more flexibility: they can execute between two and three million instructions per second, that is as fast as many main-frame computers, and can process software programs more than three times as fast as the 68000.

Power requirements of these new chips are the same as that of the 68000 although they contain three times as many transistors. This low power consumption, which minimizes heat problems, and the high speed coupled with a large memory mean that very small but very powerful computers can be built. As a result, highly complex mathematical and engineering problems can be executed by a desktop computer and up to twenty people can work on the same computer file simultaneously.

Personalized computers have recently become available in the USA from Metaphor. These machines are customized for groups of users, such as accountants. Metaphor expects users, untrained in programming, to take it from there and write further applications for themselves. So, here is already an example of what can nowadays be done by the user himself that had to be done by specialized programmers only a few years ago.

The two important developments are, however, the use of natural instead of man-made language (such as BASIC or FORTH) and graphics. The ability to speak into a computer instead of having to sit down at a keyboard will increase the uses of computers vastly. Basically, what is required for this is an interface between the user and the computer: a device such as a voice-actuated typewriter (vat) that can transcribe speech without having to understand it.

As the problems facing designers of automatic speech recognition (ASR) systems are enormous, large programmes, many government sponsored, have been initiated in Britain (the Alvey programme, named after John Alvey who chaired the committee that established the programme in 1982); in Europe (the European Strategic Programme on Research in Information Technology — ESPRIT); in the USA (Defence Advanced Research Projects Agency — DARPA; — Microelectronics and Computer Technology Corporation — MCC — the civilian counterpart of DARPA; and Semiconductor Research Cooperative — SRC); and in Japan (Institute for new-generation Computer Technology — ICOT — and the National Superspeed Computer Project).

Several of the world's big computer companies have been working on automatic speech recognition (ASR) for some time. A few months ago, IBM announced that it had produced an experimental system with a ninety-five per cent recognition rate for a 5000-word business vocabulary. There are two approaches to ASR, of which one relies on a template recognition system. Templates are digital patterns used by a recognition algorithm to identify words. The other is based on pattern analysis of the forty phonemes that make up spoken English, and the 1600 transitions possible between each adjoining pair of them.

All the signs are that by the year 2001 we will be able to emulate HAL (but only as far as its positive aspects!) and command computers through natural language, because that is, and will remain, the most efficient and subtle, though complicated, instrument for human communication.

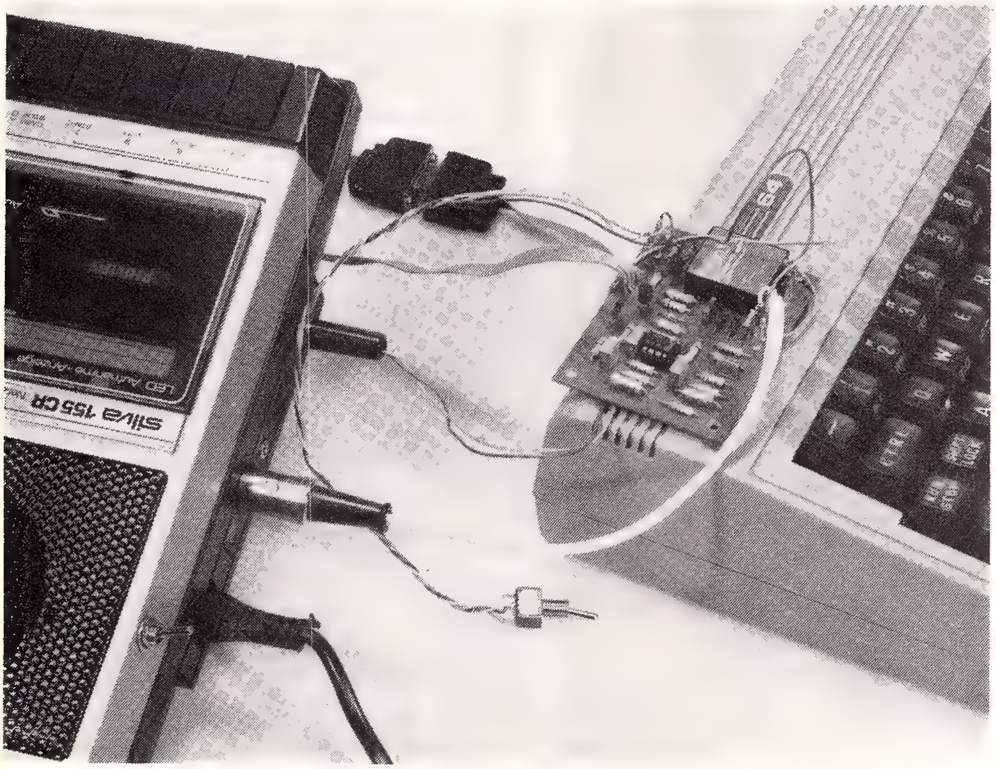
Visual representation is virtually useless to convey certain kinds of information. But when it comes to show the relation between, say, forecast and actual sales, pictures come into their own.

Unfortunately, many companies have been frightened by the experience of Mindset. This Silicon Valley company makes an IBM compatible PC that produces high-quality graphics. After this set had been hailed by the press at its launch early last year, it flopped. Although there were market reasons for this, the main disappointment was that the idea that good graphics would create its own market among general business users was wrong. None the less, most consultants are forecasting that the computer graphics industry is heading for a huge boom, with a growth rate of more than forty per cent per year for the remainder of the 1980s.

Good graphics will be possible because PCs are becoming powerful enough to use bit mapping, a technique in which each pixel can be controlled individually. The most impressive PC with a bit-mapped high-resolution screen is Apple's MacIntosh, while in the business market it is IBM's 3270PC/G (which, incidentally, also has a mouse).

Finally, two new printing technologies are becoming economically available. Up till now, there have been three basic types of printer: daisywheel, producing good quality print slowly and loudly; dot matrix, which uses a row of fine needles shot forward by electrical pulses to form the shape of letters and figures and is faster but less clear than the daisywheel; and heat transfer, which also uses needles but, instead of moving, these heat up momentarily.

But the future will almost certainly belong to laser and LCD (liquid crystal display) printers, both of which are fast (6...7 pages of A4 per minute), noiseless, and give a print quality where you do not notice any dots (pixels). Printers using these techniques are still very expensive, although market forecasts are that there will be a laser printer on the market for under £1000 in about a year's time.



Commodore cassette interface

Necessity being the mother of invention this circuit was destined to be designed. The 'necessity' here is Commodore's insistence that the VIC 20 and C64 computers can only be used with a special cassette recorder supplied by . . . Commodore. One of our designers baulked at the idea of buying a cassette recorder only for his computer when he already had a perfectly good audio recorder. Some kindly soul directed his outraged energy towards the nearest soldering iron and so was born THE Commodore cassette interface by Elektor.

THE alternative

As in many home computers, the data output by the VIC 20 and C64 via the cassette interface is in the form of a square wave signal with an amplitude of 5 V_{pp}. The information input to the computer has the same form. The cassette connector also contains a so-called 'sense input' that enables the computer to check if the recorder's PLAY button is pressed. The Commodore will only activate its motor output if this is the case. The computer itself switches the recorder motor on and off and we will see later how this is actually done. First, however, we must see what happens if the computer wants to save a file on cassette.

THE interface in detail

The program to be saved appears in the form of pulses with an amplitude of 5 V_{pp} on the write output of the connector. This amplitude is, of course, much too large to be saved directly on the tape so the signal is first reduced to about 200 mV by voltage divider R13/R14. This signal is then suitable for recording on the tape.
The procedure for loading a program is somewhat more involved. The signal supplied by the recorder via a DIN or loudspeaker output socket is nowhere near square in shape and its amplitude is also much too small, at about 200 to 300 mV. The signal must therefore be amplified and its shape improved. A single op-amp (A1) increases the signal's amplitude by about six times. The offset of A1, and consequently of A2, is set to half the supply voltage by means of R3 and R4. The second op-amp is set up as a schmitt trigger which takes the signal from A1 and forms it into a clean square wave signal with an amplitude of 5 V_{pp}. The computer can now load the program via the connec-

1

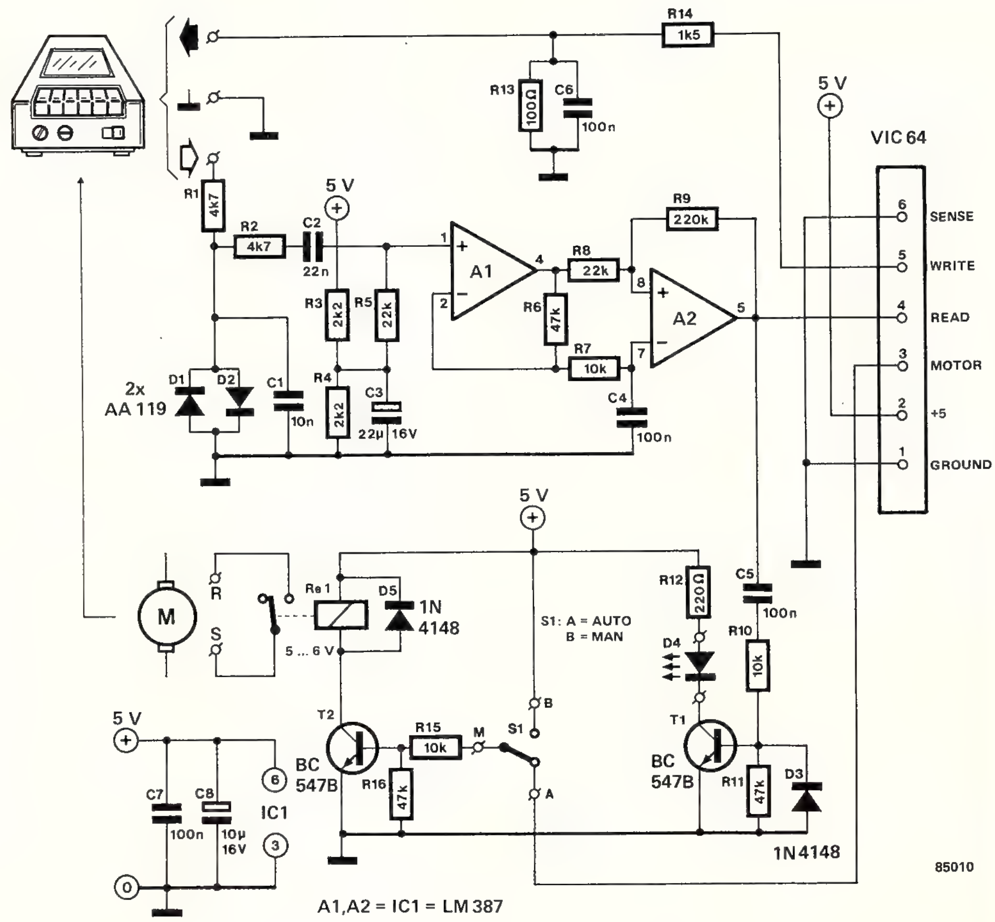


Figure 1. Looking at how simple this cassette interface is, you may wonder why Commodore found it necessary to insist on a special recorder. We did!

2

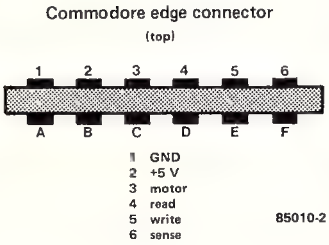


Figure 2. This is the layout used by the six-way edge connector on both C64 and VIC 20 computers.

tor's read input. A LED (D4) has been included in the circuit to show that this is actually happening. It will only light when transistor T1 is caused to conduct by a '1' appearing on its base but the logic levels switch far too fast to be seen with the naked eye. When data is being transferred the LED appears to be continually on. One obvious advantage of this LED is that it simplifies finding the start of a program. The motor in the cassette recorder must be switched on and off at the right times by the computer. Naturally enough this is done via a relay (Rel) instead of directly. When pin 3 of the connector goes high transistor T2 is switched on and causes the relay to operate. First of all, however, the computer must be made to think that the PLAY button is pressed. This condition is simulated by connecting the sense input to ground, which is exactly what happens in the Commodore data recorder when this button is pressed. If the sense input is connected straight to ground, as we have done, we can then simply forget about it. The power supply for the interface is very kindly provided by the computer. As figures 1 and 2 show, pins 1 and 2 of the cassette connector are GND and +5 V respectively. This makes a separate supply for the circuit unnecessary.

The interconnections

Before any data can be transferred all the electronics must be constructed and all interconnections must be made. A total of six links are needed at the computer side and the most important point here is to ensure that none of these are interchanged. The computer would not be very pleased with this so have a look at figures 1 and 2 to see where everything belongs before soldering any wires. The cassette recorder is more tolerant of wrong connections but it is far better if the circuit works correctly first time. Again make sure to solder the right wires in the appropriate places. The layout usually used for a cassette recorder's DIN socket is illustrated in figure 3. The two terminals for the relay contacts (points R and S in figure 1) are linked to the recorder's remote input via a jack plug. If the tape recorder in question does not have any remote input this is no reason for panic; simply connect R and S in series in one of the voltage supply lines to the motor.

Installation and use

All the components must be fitted to the printed circuit board shown in figure 4 and when this is done a suitable case must be found for the circuit. Alternatively, it may be possible to include it within the cassette recorder case. Whichever of these is chosen there is one point to bear in mind: the connecting wires must not be made too long. A special connector is needed to link the interface to the computer's cassette input/output lines. This is a six-way printed circuit board connector with a spacing of 3.96 mm (0.156") between the pins. The wires can also be soldered directly onto the printed circuit board. We will be very brief in our instructions on using the circuit: refer to page 18 of the C64 user's manual.

The function of S1 in the circuit is clear. It is used to switch the motor on and off, which is very handy for winding the tape. If an error message is generated during loading the volume control on the cassette recorder is probably not correctly set. When reading tapes that you have not recorded yourself it may be necessary to re-align the record/playback head. If our experiences with this interface are anything to go by, however, errors will rarely occur, even when 'turbo' loading. ◼

3

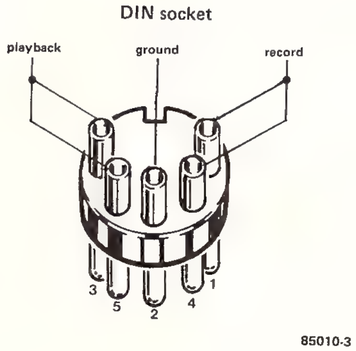
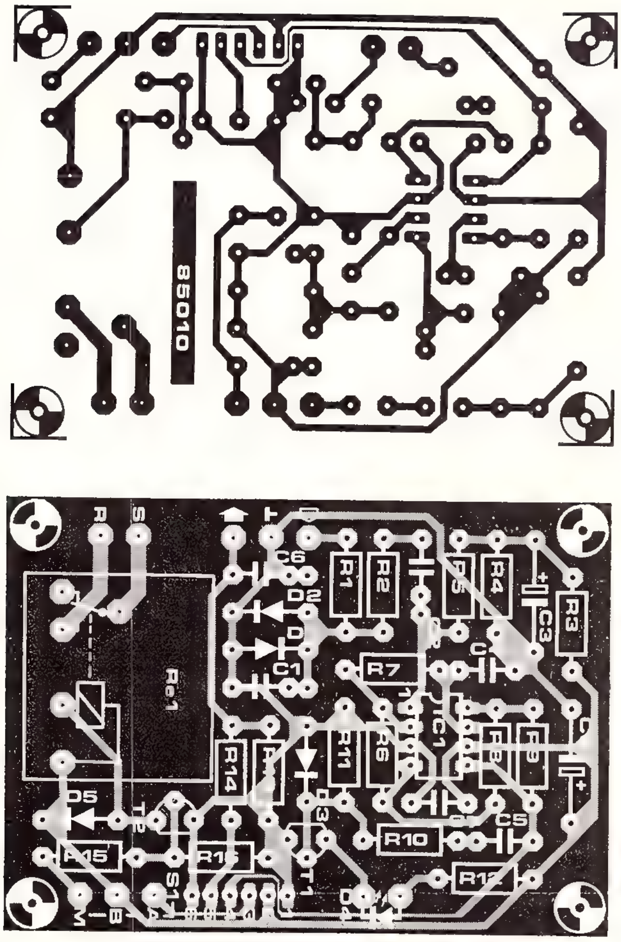


Figure 3. Here is the arrangement most commonly used when a cassette recorder has a DIN socket for input/output.

4



Parts list

Resistors:
R1, R2 = 4k7
R3, R4 = 2k2
R5, R8 = 22 k
R6, R11, R16 = 47 k
R7, R10, R15 = 10 k
R9 = 220 k
R12 = 220 Ω
R13 = 100 Ω
R14 = 1k5

Capacitors:
C1 = 10 n
C2 = 22 n
C3 = 22 μ/16 V
C4. . .C7 = 100 n
C8 = 10 μ/16 V

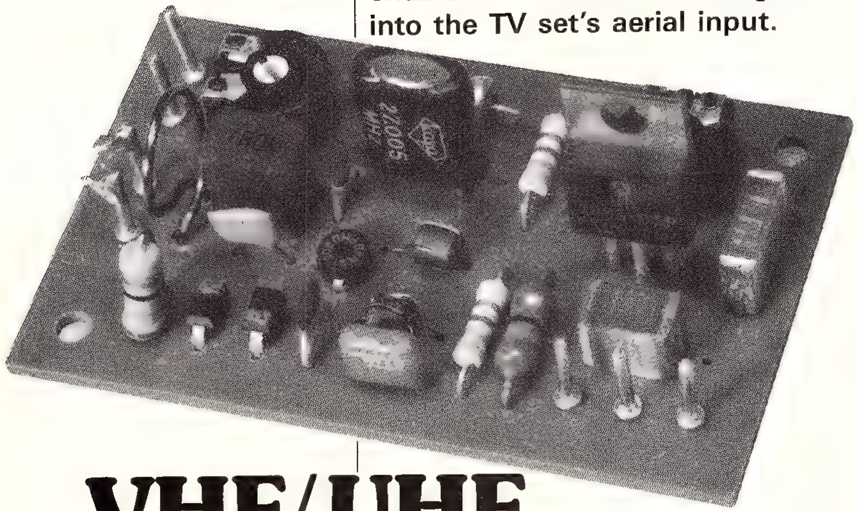
Semiconductors:
D1, D2 = AA119
D3, D5 = 1N4148
D4 = LED
T1, T2 = BC547B
IC1 = LM387

Miscellaneous:
Re1 = relay, 6 V PCB-mounting type (*MS Components — part no. 8055*)
S1 = single-pole toggle switch
6-way PCB edge connector with pin spacing of 3.96 mm (0.156" — *Maplin, order no. FG24B*)

Figure 4. Constructing the circuit is simply a matter of assembling the components on this printed circuit board. Make sure no wires are switched when making the interconnections.

VHF/UHF TV modulator
Elektor january 1985

Computers, video games, video cameras, games computers; all of these produce video signals that must be displayed via a television set. If the TV receiver in question does not have a video input and its owner is reluctant to vandalise it in order to fit one then this sort of modulator is the obvious solution. It is a simple circuit that processes video signals to enable them to be fed straight into the TV set's aerial input.



VHF/UHF TV modulator

for any TV set without a video input

A 'TV modulator' is really no more than a transmitter. It is a very small transmitter, admittedly, but none the less that is what it is. What does a modulator actually do? In general — and this design is no exception to the rule — it is a simple oscillator that generates a frequency somewhere in the VHF or UHF region. The oscillator is modulated with the video signal and the modulated carrier wave thus generated is fed into the TV set's aerial input via a cable. Then all that remains to do is tune the TV to the correct frequency.

The layout

The whole business is not quite as simple as we have just suggested, of course, as the mini transmitter must meet certain requirements. The frequency stability must be very good as, indeed, must the quality of the display. The required frequency stability is achieved by the use of a crystal oscillator. A well thought out choice of component values takes care of the display quality: the modulator allows a resolution of 80 characters per line, as this is a value that is often needed.

1

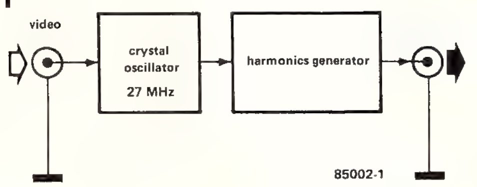


Figure 1. A TV modulator is, in fact, a small TV transmitter. In this case the transmitter consists of a modulatable (AM) oscillator followed by a harmonics generator.

A very important feature of the circuit that must be decided is the transmission frequency. If this is only a single channel, as suggested above, it gives rise to some practical problems. Different users will want different channels, the carrier wave can become somewhat difficult to locate, and unless the frequency is exactly spot on no signal will be received. A much better idea is to ensure that the HF signal contains a large number of different frequencies. This makes it much easier to tune the TV set to one of the frequencies as there will surely be one to suit every user.

The block diagram of figure 1 shows how this is achieved. The TV modulator is made up of two parts, namely a modulatable crystal oscillator and a harmonics generator. The oscillator operates at a frequency of 27 MHz, which is quite low so inexpensive crystals are readily available. The harmonics generator converts the oscillator signal into a sort of frequency spectrum containing all the multiples of 27 MHz up to about 1800 MHz. The TV modulator's output signal is made up of a large number of little peaks, each of which is a complete transmitter signal. At least one of these will always be in band I (VHF channels 2. . .4), one in band III (VHF channels 5. . .12) and many of them will be in bands IV and V (UHF channels 21. . .69).

The circuit diagram

Like the block diagram, the circuit (shown in figure 2) is very straightforward. The crystal oscillator is based on a very fast HF transistor, T1 (BFR91), which performs the amplitude modulation. Apart from this there is little to be said about the oscillator except, perhaps, that it is essential to use the correct values for the components surrounding T1. This is, of course, simply common sense in this sort of HF circuit.

The harmonics generator is formed by two Schottky diodes, D1 and D2. These diodes must switch very quickly in time with the 27 MHz signal so they provide strong harmonics up into the gigahertz range.

The modulation depth can be set with P1, while the oscillator's d.c. value can be varied by means of P2. The combination of these two presets enables either positive or negative amplitude modulation to be selected. This is essential as the harmonics produced vary in this respect. We will discuss the calibration of P1 and P2 later in this article.

The power for the circuit can be provided by either an unstabilized 8...30 V or a stabilized 5 V. The latter could be taken from a computer's power supply and in this case IC1 is not needed.

Construction

The tiny printed circuit board designed for this circuit is shown in figure 3. It is

2

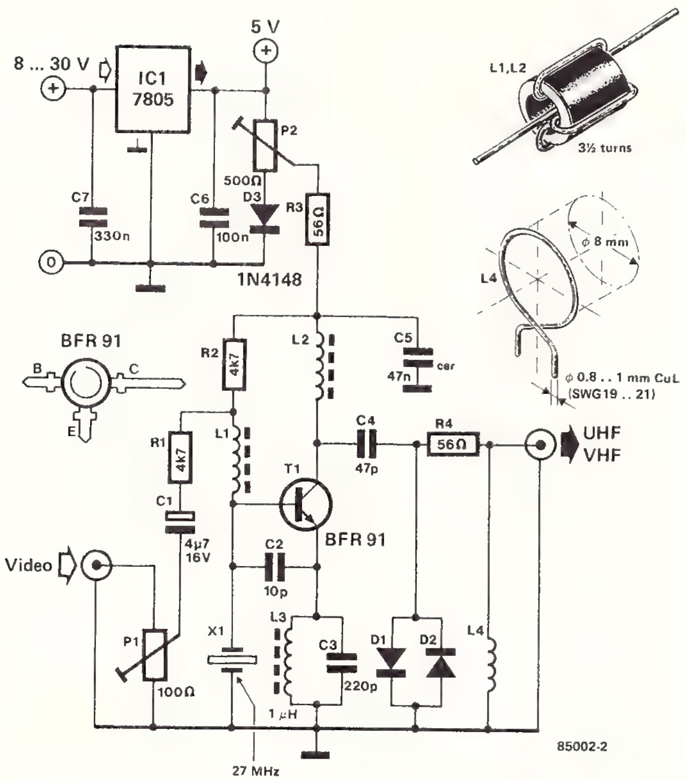


Figure 2. In this circuit diagram we see that the 27 MHz oscillator is based on transistor T1 and the harmonics are generated by Schottky diodes D1 and D2.

not double-sided as this was found to be unnecessary. Construction is thereby simplified and readers who do not buy the board through our EPS service (tut-tut) will find it easier to make themselves. Building the circuit is simply a matter of fitting the components onto the printed circuit board. The coils, often a source of much teeth-gnashing and hair-pulling, will not be a problem in this case. Two of them, L1 and L2, are made by winding 3½ turns of enamelled copper wire (about 0.2 mm thick) on a 3.5 mm ferrite bead. Another, L4, is just one turn of copper wire (0.8...1 mm thick) air-wound with a diameter of 8 mm. The fourth inductor, L3, can simply be bought.
Any third overtone crystal with a frequency of between 25 and 30 MHz will work in this circuit. A number of suitable values are advertised in this issue.
The only parts that might prove difficult to find are diodes D1 and D2. The ones stated in the parts list are available at the moment but do not give up hope if your corner shop does not have them. The only important thing is that they must be UHF Schottky diodes; the actual type number is of little consequence.

Calibration

Calibrating the modulator calls for a certain degree of care as it involves more than just 'set the presets to mid-position'. The setting depends, in fact, on the harmonic to which the circuit is tuned. Calibration should be carried out as follows:

- Set the TV receiver to maximum brightness and contrast.
- Feed a video signal into the modulator (a video recording of a test card, or a link to a computer's 'TV' socket, could be used) and connect the circuit's output to the TV's aerial input.
- Set P2 to mid-position and P1 to minimum resistance (fully anti-clockwise).
- Tune the TV receiver to a harmonic, preferably one of the VHF bands (channels 2...12). The tuning is correct when the 'snow' on the screen disappears and/or the screen becomes dark.
- Turn P1 very slightly until 'something' becomes visible.
- Calibrate P2 to give the best possible quality image. If the result is not very good the wiper of P1 can be moved a bit more and P2 again trimmed to give a better image.
- If this still fails to provide an acceptable result tune the TV to the next harmonic. This must give a decent image.

3

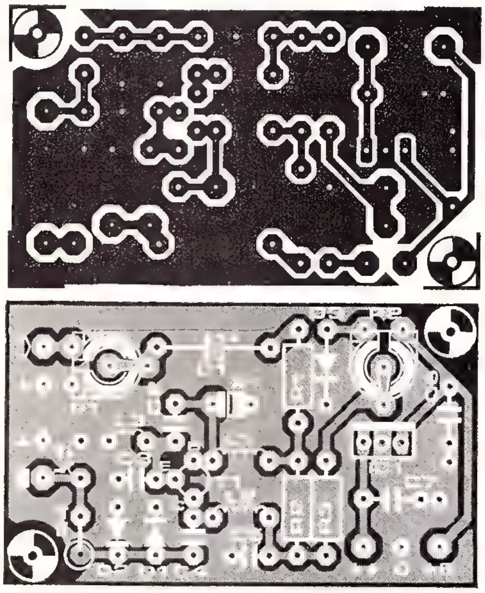


Figure 3. Fortunately the printed circuit board for the modulator is only single-sided. The large copper surface acts as a ground plain.

Parts list

Resistors:
R1, R2 = 4k7
R3, R4 = 56 Ω
P1 = 100 Ω preset
P2 = 500 Ω preset

Capacitors:
C1 = 4µ7/16 V
C2 = 10 p
C3 = 220 p
C4 = 47 p
C5 = 47 n, ceramic
C6 = 100 n*
C7 = 330 n*

Inductors:
L1, L2 = 3½ turns of 0.2 mm (SWG 35 or 36) CuL on a ferrite bead of about 3.5 × 3.5 mm
L3 = 1 µH
L4 = 1 turn of 0.8...1 mm (SWG 19...21) CuL, air-wound with a diameter of 8 mm

Semiconductors:
D1, D2 = 1N6263 (*Ambit/Cirkit*)
D3 = 1N4148
T1 = BFR91 (*Ambit/Cirkit*)
IC1 = 7805*

Miscellaneous:
X1 = crystal, 27 MHz (3rd overtone) or other 3rd overtone crystal between 25 and 30 MHz

* = not needed if the circuit is powered from a stabilised 5 V supply

portable guitar amplifier

with a host of facilities

Apart from output power and the choice of valves or transistors as active elements, there is not much to distinguish the multitude of commercial guitar amplifiers on the market. All that most of them offer is a three-channel equalizer for bass, mid-range, and high frequencies, and a built-in reverberation spring: this does not give the musician much scope for experimentation. Yet, even for only a modest outlay is it possible to bring some colour to the monotony of the basic sound of the strings. This is made possible by a voltage-controlled filter — surely no stranger to our musical readers.

The controls for bass, mid-range, and high frequencies on most commercial guitar amplifiers may be compared with those on a hi-fi installation. Unfortunately, they do not change the basic character of the sounds produced by a guitar string: to do so, many more additional units are required: phaser, chorus, flanger, fuzz box, and so on. In many cases, these units really do mellow the harsh notes produced by the guitar. The amplifier described here does not, and is not intended to, replace such additional units entirely. However, several of the add-on units are based on similar principles and can be imitated fairly easily, and well, by the voltage-controlled filter on which the design of the present amplifier is based. Mixing the outputs of a voltage-controlled filter (VCF) allows the continuous transition from all pass to notch mode. Furthermore, the signal from the integral fuzz circuit may be added to the outputs of the VCF, so that with only four potentiometers a whole spectrum of tone colour variations becomes available.

Voltage-controlled filter (VCF)

The VCF is a simplified version of that used in the Formant synthesizer (see *Elektor* December 1977, page 12-27). It is built from opamps A2, A3, and A4 as shown in figure 1, which function as high pass, band pass, and low pass filter respectively. Stereo potentiometer P3 enables the setting of a specific turnover point, that is, the centre frequency of the band pass filter.

Overdrive (fuzz) circuit

Either the direct or the filtered signal from the guitar may be fed to opamp A5 by switch S1. The gain of the amplifier can be set within wide limits by P2: this is vital because the stage following A5 needs a threshold to function as limiter and so provide the required amount of distortion. The use of three pairs of diodes results in a smoother onset of limiting, that is, a progressive increase in distortion, which provides a tone reminiscent of valve amplifiers. The operation of the overdrive circuit is clarified in figure 2.

Mixing

Potentiometers P6...P9 allow the mixing of the outputs of the filter and the distortion generator: the wipers of all four are connected to the inverting input of opamp A7. Preset P10 enables the setting of the required feedback factor: the higher its value, the greater the gain of A7.

Reverb(eration) unit

Reverberation springs have been a welcome addition to guitar amplifiers for a long time. Although they do not perform miracles, they add to the fullness of the sound.
The principle on which they work is that the sounds to be reverberated are magnetically coupled to one or two metal

1

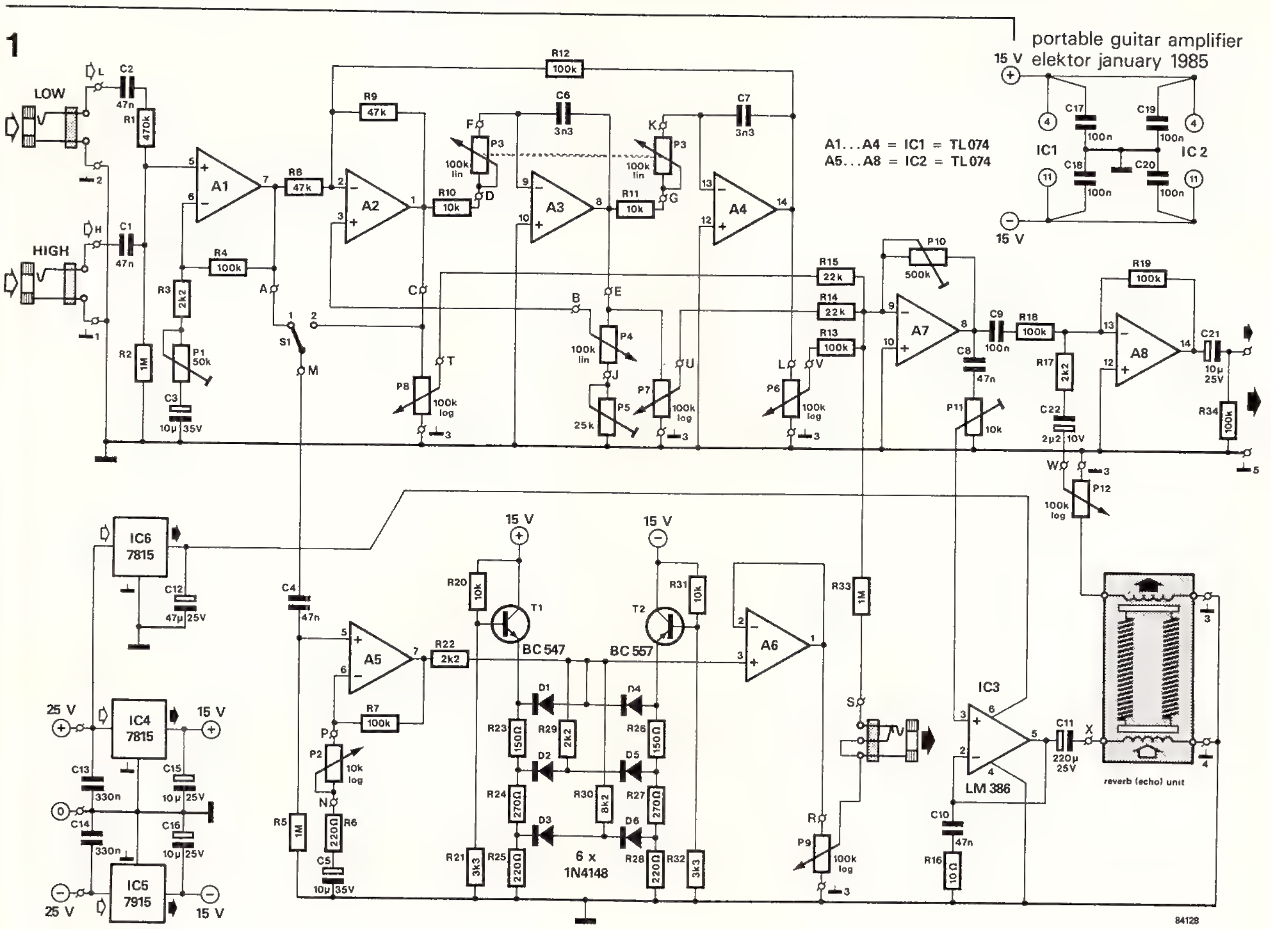


Figure 1. Circuit diagram of the pre-amplifier.

springs. Because of the elasticity of the springs, the mechanical waves to which the signals from the guitar have been converted take a certain time to reach the other side of the spring where they are reconverted to electrical signals. Integrated a.f. amplifier IC3 drives the input coil: a standard opamp would not be able to provide sufficient energy, that is, output current.

Opamp A8 is a mixer in which the direct and the reverberated signals are added together. Potentiometer P12 enables continuous adjustment of the level of the echo. The relatively low value of R17, compared with that of feedback resistor R19, provides a fiftyfold gain of the reverberated signal.

Calibration

The potentiometers are all brought out at the front panel and their setting will be discussed under 'operation and setting up'.

Depending on the type of pick-up used, the peak value of the signals produced by an electric guitar vary widely. Preset P1 determines the gain of input amplifier A1. To start with, set the wiper of this control to the centre of its travel. Then connect the output of A1 (pin 7) to the output amplifier, and connect an electric guitar to the input of the circuit. If the 30-watt a.f. output stage described elsewhere in this issue is used, set the potentiometer, P13, between A1 and that amplifier to maximum. Also, set the volume control on the guitar to maximum.

The maximum required volume can now be set with P10, but only after P6...P8 have been turned open (wipers at output of opamps A4, A3, and A2 respectively), P3 and P4 have been set to the centre of their travel, and P9 and P12 so that their wipers are at earth potential. The setting of P2 is immaterial. When all this is done, the basic sound of the guitar, without distortion and reverberation, should be heard in the loudspeaker. If the sound is distorted, it probably means that A1 is overloaded. The remedy is to reduce its gain with P1. If you have an oscilloscope, check that the signals at the output (pin 7) of A1 are not being limited.

It may also be that the output stage is overloaded; in that case, reduce its gain with P13 until the sound is fairly soft.

If there is still distortion, A7 or A8 may be overloaded: the remedy for this is to

2

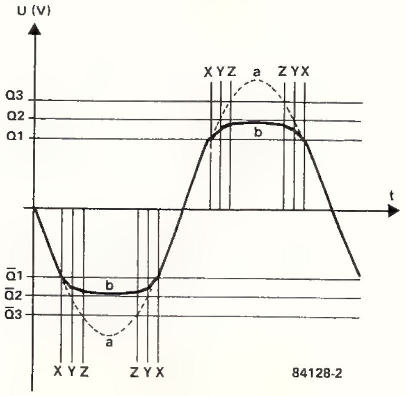


Figure 2. A clean sine wave (a) at the input of the overdrive (fuzz) circuit appears flattened (b) at the output if its peak value is equal to, or exceeds, the thresholds, Q1...Q3, of the three pairs of limiting diodes. At x the first diode pair starts to conduct, at y, the second also, and at z all diodes conduct.

reduce the gain of A7 with P10. Again, if you have an oscilloscope, the output of A7 (pin 8) or of A8 (pin 14) may be checked for clipping. It is, however, very unlikely that there is overloading of these stages.

Setting the reverberation

The level of the signal applied to the reverberation exciter coil is determined by preset P11. To find the correct level, first set P12 to maximum. Next, move the wiper of P11 slowly from earth potential and simultaneously pluck one of the guitar strings. If everything is all right, the echo should become clearer and clearer. However, at a certain point, that is, when the output level of IC3 becomes too high, the echo becomes muffled and suffers from frequency-dependent distortion. To avoid this happening even when the guitar is plucked vigorously, carry out this test with firm plucking of the string. If the echo is too weak with P11 and P12 at maximum, it may be enhanced with P10, even though this also increases the level of the direct signal.

3

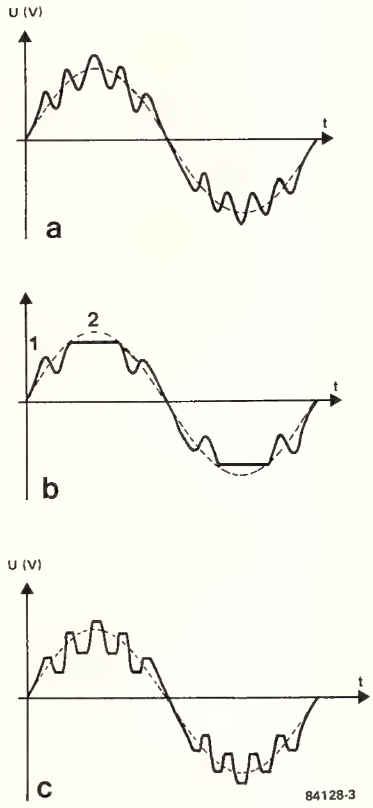


Figure 3. If a composite signal (a) is distorted through limiting, the higher frequencies may be chopped (b, 2) or not be affected at all (b, 1). A more pleasant sound ensues if first only the high frequencies are limited and then superimposed onto the lower ones (c).

4

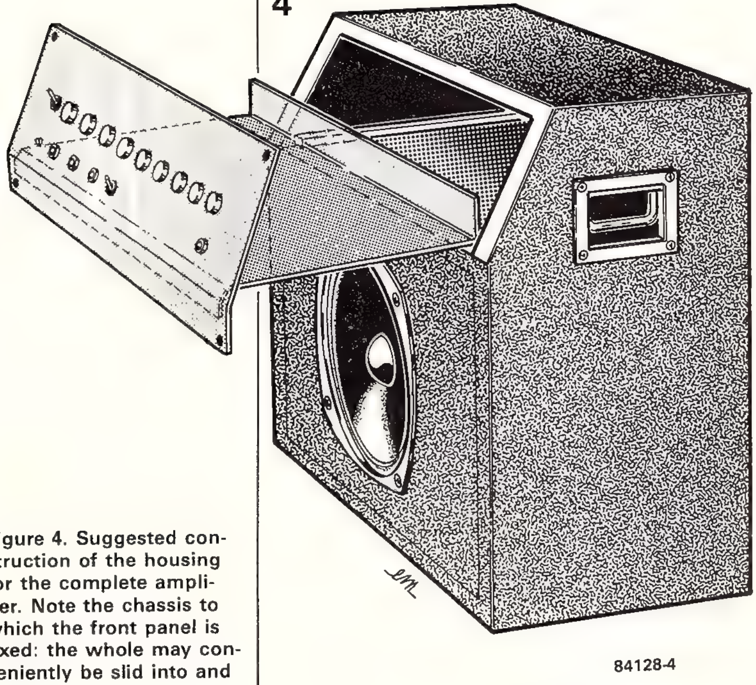


Figure 4. Suggested construction of the housing for the complete amplifier. Note the chassis to which the front panel is fixed: the whole may conveniently be slid into and out of the case.

Operation and setting up

Playing without overdrive (fuzz): set P9 to zero (wiper at earth) and with P6...P8 choose the desired bass, mid-range, and treble response. It is important that the setting of each of these controls is compatible with that of the others. When all three are set for identical gain, the output of the guitar sounds virtually natural.

Potentiometer P4 is of considerable importance to the operation of the VCF: it determines the quality, Q, that is, the slope of the pass band of the filter. When the Q is high (steep slope) it is possible to produce artificial resonance peaks in the band-pass characteristic which give the sound a distinct colouring. This is also affected to some extent by the setting of P3.

Varying P3 (imagine this control fitted in a foot-operated swell) with Q high and only the low-pass filter section operating causes a wa-wa effect. With a low Q and the mid-range frequencies attenuated, slowly altering the crossover frequency gives rise to a phasing effect.

When the wiper of P4 is at earth potential, the VCF functions as an oscillator and it is therefore necessary that P5 is adjusted so that with maximum Q the filter just does not oscillate.

Playing with overdrive (fuzz): when switch S1 is in position 1, the entire sound from the guitar becomes overdriven. Unlike many other guitar amplifiers, the present one allows the continuous mixing of the original and overdriven sounds: this may be arranged by a foot switch connected to jack socket S (see figure 1). If only the overdriven sound is wanted, potentiometers P6...P8 must be turned off completely (wipers at earth).

The degree of overdrive may be set with P2 to individual taste.

When S1 is in position 2, only those frequencies that lie above the crossover point set by P3 will be overdriven. If you mix the fuzzy high frequencies with the original low ones, a very pleasant, hoarse sound ensues that cannot be produced by a traditional fuzz box (see figure 3).

Because of space considerations, we cannot describe all possible sound variations, but hope that the examples given will spur you on to further experimentation.

Power output stage

A low-weight, portable guitar amplifier of modest dimensions requires a power output stage that is small, reliable, efficient,

5

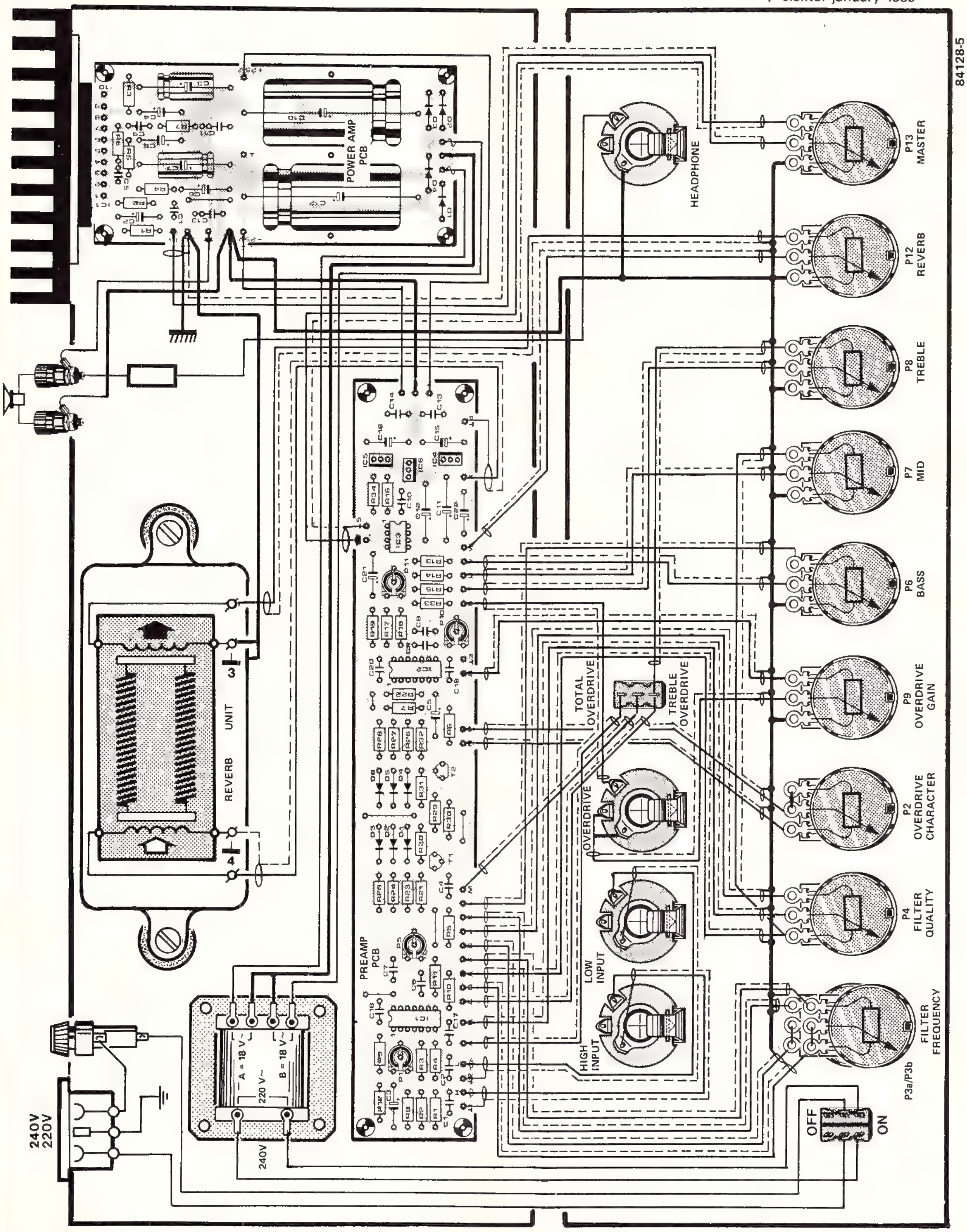


Figure 5. View of the top of the chassis and the rear of the front panel. It is important to adhere to the wiring layout to prevent earth loops. Do not forget to insulate all sockets from the front panel!
All dashed lines indicate screened cables. Screens must only be connected to earth where shown or at the front panel.

and yet provides sufficient power to prevent the audience reaching for their hearing aids! To cut a long story short, we have opted for the 30-watt output stage described elsewhere in this issue. The complete set-up gave very satisfactory results during tests and operation in small to medium-sized halls; it would probably not be quite suitable for use in larger spaces.

Power supply

Power for the pre-amplifier is derived from the supply of the 30-watt output stage: the printed circuit of that stage is already fitted with appropriate take-off terminals.
If you do not use the 30-watt output stage, you need a supply that is capable of providing ±18 . . . ±25 V at 35 mA (positive line) and 22 mA (negative line).

6

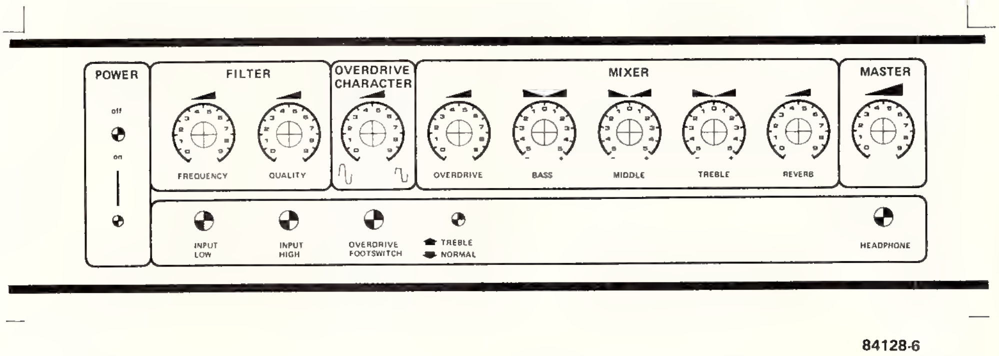


Figure 6. Suggested front panel of the guitar amplifier. It is, unfortunately, not available ready-made from Elektor Publishers.

Loudspeaker

Never use a loudspeaker designed for use in hi-fi installations for the following reasons. The amplitude of a vibrating guitar string is not particularly large: in the case of the top strings, it is hardly possible to see with the naked eye whether they are vibrating, especially if plucked only lightly. The amplification consequently required to make them audible is quite considerable.

If, however, a string is plucked vigorously, because of the type of music or the temperament of the player, it is deflected quite a distance from its rest position. The instantaneous voltage then induced in the pick-up coil reaches a very high peak and, in modern hi-fi equipment, this is faithfully transferred to the loudspeaker which in consequence may easily be damaged or destroyed. Fortunately, there are loudspeakers available which have been specially designed for use with electric guitars. They are characterized by a very rigid suspension of the cone and their ability to cope with the wide dynamic range of electric musical instruments.

Basically, the loudspeaker should be able to handle not less than 50 watts (sine wave) and have an input impedance of 8 ohms or 4 ohms. Note that mid-range and treble speakers are not just superfluous but unwanted! After all, we are not looking for linear transfer of the guitar sounds: it is the unfaithfull reproduction that makes the music of electric guitars so popular!

Construction

The complete amplifier, including loudspeaker, may be housed in a case as suggested in figure 4. The shape corresponds closely to current market trends. Dimensions are primarily dependent upon the loudspeaker: unfortunately, we have not been able to find a suitable speaker that would make it possible to house the amplifier in a truly portable case.

The top compartment of the wooden case offers ample space for the pre-amplifier, output stage, and power supply.

The best material to use is 19 mm (¾ inch) chipboard. The various panels should be fastened together with dowels and wood glue: if you must, chipboard screws may also be used.

The completed case may then be covered in, say, black leatherette and the corners protected by suitable metal corner pieces to give the whole a near-professional appearance.

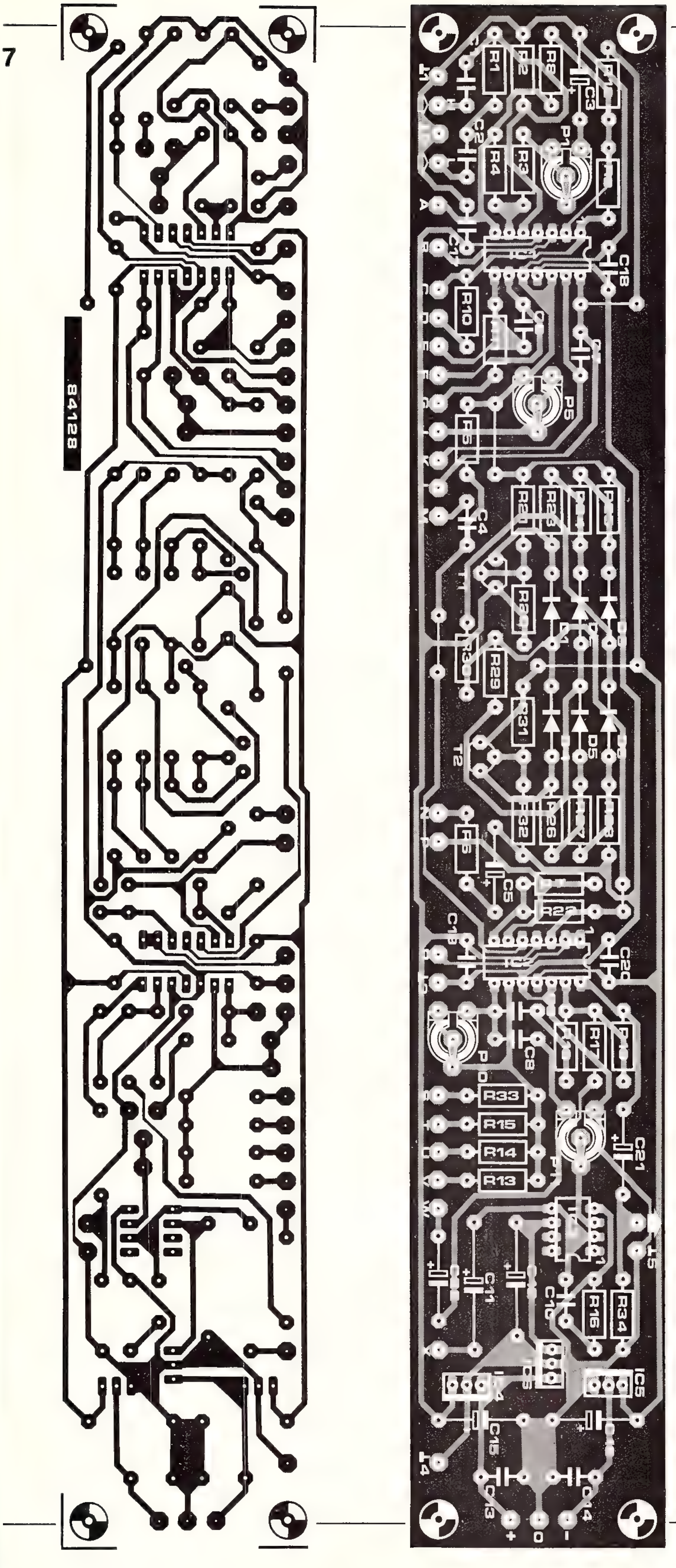
The electronic circuits are best mounted onto a chassis which is fastened to the front panel so that the whole may be slid in and out of the upper compartment. The front panel should be fastened to the case with suitable chipboard screws. It is wise to fit two runners at the underside of the chassis so that it does not lie direct on the wood: this has the advantage that any fixing screws for the transformers, PCBs, and so on may protrude from the underside of the chassis without causing any problems.

Some useful hints

If the wiring to the potentiometers, the power lines, and the wires connecting the pre-amplifier to the output stage are not placed with careful thought, it may easily happen that hum is audible from the speaker even when all potentiometers are turned off. One of the prime causes of this is that the earth connections to various parts are not radial but form a loop. If such a loop lies in a stray field, a voltage may be induced in it which is then superimposed onto the signal. Care should also be taken that signal paths and wires (including PCB tracks) carrying unsmoothed alternating currents never have a common return. It is for these reasons strongly recommended to adhere to the interconnection wiring layout in figure 5.

When fitting the reverb unit, care should be taken that the output coil is not too close to the mains transformer. The screened housing of the unit does not offer all that much protection against the strong electro-magnetic field existing in the immediate vicinity of the transformer. It is also best not to fit the unit rigidly to the chassis to prevent any mechanical vibrations from the loudspeaker and mains transformer being transferred to it. This is easily accomplished with a felt washer fitted between the chassis and the unit housing: it is wise to glue the washer in place. ◼

7



Parts list

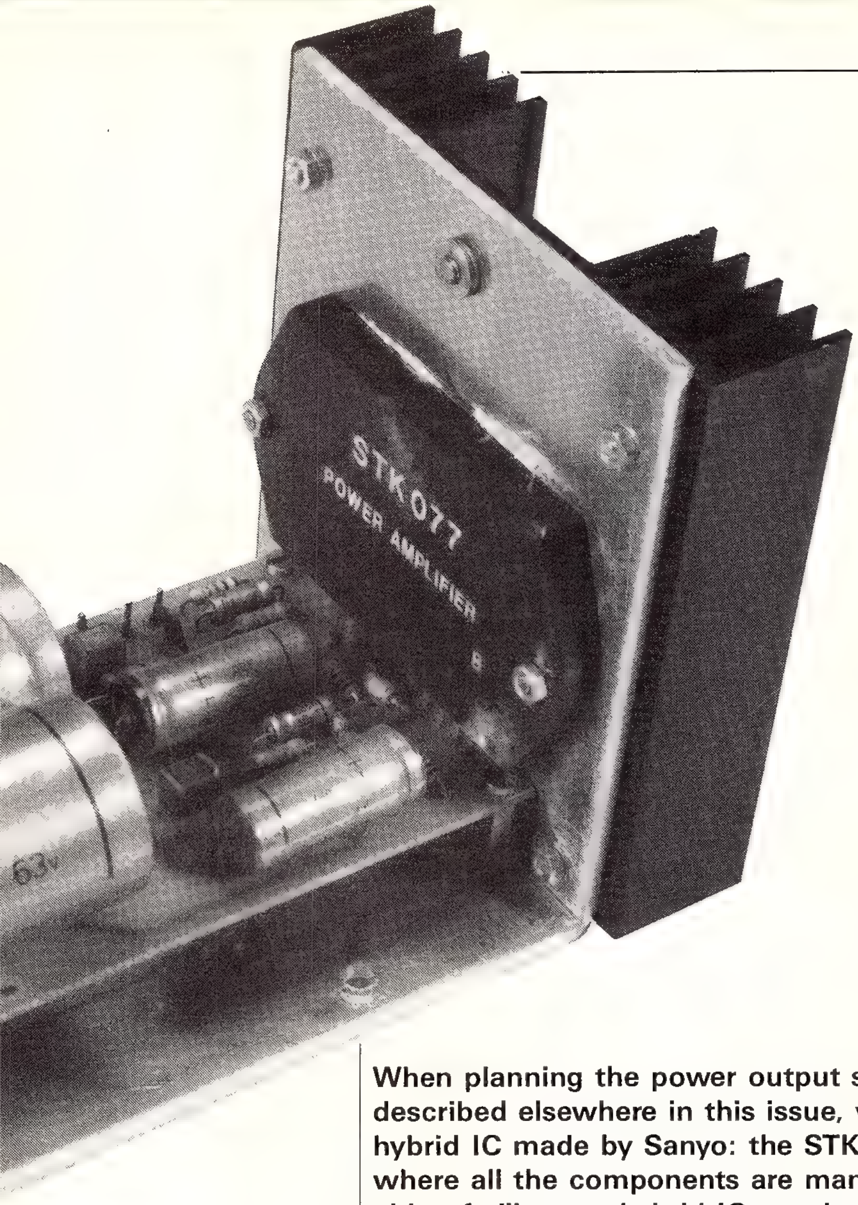
Resistors:
R1 = 470 k
R2,R5,R33 = 1 M
R3,R17,R22,R29 = 2k2
R4,R7,R12,R13,R18,R19,
R34 = 100 k
R6,R25,R28 = 220 Ω
R8,R9 = 47 k
R10,R11,R20,R31 = 10 k
R14,R15 = 22 k
R16 = 10 Ω
R21,R32 = 3k3
R23,R26 = 150 Ω
R24,R27 = 270 Ω
R30 = 8k2
P1 = 50 k preset, PCB type
P2 = 10 k potentiometer, log.
P3 = 100 k potentiometer, stereo, lin.
P4 = 100 k potentiometer, lin.
P5 = 25 k preset, PCB type
P6,P7,P8,P9,P12 = 100 k potentiometer, log.
P10 = 500 k preset, PCB type
P11 = 10 k preset, PCB type

Capacitors:
C1,C2,C4,C8,C10 = 47 n
C3,C5,C15,C16,
C21 = 10 μ/35 V
C6,C7 = 3n3
C9,C17,C18,C19,
C20 = 100 n
C11 = 220 μ/25 V
C12 = 47 μ/25 V
C13,C14 = 330 n
C22 = 2μ2/10 V

Semiconductors:
D1 . . . D6 = 1N4148
T1 = BC 547
T2 = BC 557
IC1,IC2 = TL 074 (TL 084)
IC3 = LM 386
IC4,IC6 = 7815
IC5 = 7915

Miscellaneous:
S1 = SPST switch
2 jack socket, 6.3 mm, mono, without switch
1 jack socket, 6.3 mm, mono, with switch
printed circuit board 84128

Figure 7. The printed circuit of the pre-amplifier.



30 watt a.f. output stage

based on a new hybrid IC

When planning the power output stage for the guitar amplifier described elsewhere in this issue, we came across an interesting hybrid IC made by Sanyo: the STK077. In contrast to a monolithic IC where all the components are manufactured into or on top of a single chip of silicon, a hybrid IC consists of several separate component parts, attached to a ceramic substrate, that are interconnected by an appropriate metallization pattern or by wire bonds. Hybrid ICs are frequently encountered in medium power (30. . .60 W) hi-fi equipment. They are, however, also eminently suitable for use in home-constructed amplifiers, because they are more reliable and smaller than circuits built up from discrete components, and are not so vulnerable and susceptible to oscillation as monolithic IC stages. Hybrid ICs are generally available with power ratings up to 70 W and are normally reasonably priced.

The STK077 is a 30 watt hybrid IC that is ideal for use in small mono a.f. amplifiers or medium power stereo equipment. It is also of interest to those who want a small amplifier for fitting into an active loudspeaker box.

The innards of the STK077 form a fairly conventional a.f. amplifier circuit as can be seen from figure 1. Note that the power transistors are mounted direct on the cooling area of the device to ensure better heat dissipation.

The input of the device is formed by differential amplifier T2/T3 whose emitter resistance consists of current source T1/D1/D2. The output of the amplifier is fed to driver T6 whose collector resistance is formed by current source T4. Transistor T5 provides a constant bias voltage for the output transistors: the bias allows a quiescent current of about 50 mA through these transistors. The output transistors are arranged as quasi-complementary darlingtons: T7 and T9 form an n-p-n darlington; T8 and T10 are the complementary pair. Any asymmetry of T8/T10 is negated by diode D5.

Circuit description

The amplifier circuit, shown in figure 2, is designed for operation from a ± 25 V symmetrical power supply. The full 50 V, decoupled by C4 and C8, is applied to the output transistors, pins 6 and 8, in the STK077. The supply for the input and driver stages is decoupled by R3/C3 and R5/C7 respectively and applied to pins 10 and 4. Feedback is arranged by connecting the output, pin 7, to the inverting input of the differential amplifier, pin 3, via R6.

The gain, A, is determined by the feedback factor, that is, the ratio R6:R4 — A = (R6 + R4)/R4. With values shown this amounts to nearly 27 dB.

The input signal is applied to the non-inverting input (pin 1) of the differential amplifier. DC zero potential is ensured by resistor R2, which carries the base current for T2. Pin 2 is the earth terminal which is internally connected to the metal base of the STK077.

Stability of the output transistors is arranged by various methods. On board there is a Miller capacitor between base and collector of driver T6, while externally capacitor C5 is connected between pins 3 and 5. Capacitor C9 and resistor R7 at the output, pin 7, ensure a defined load at high frequencies and this enhances the stability under no-load conditions. Finally, the input has been provided with an RC low-pass filter (R1/C1) which increases the rise time of the input signal and so reduces the transient intermodulation distortion (TIM).

The power supply, with the exception of the mains transformer, is housed on the same printed circuit as the amplifier. It consists of an unregulated circuit: four standard diode rectifiers, and two electrolytic smoothing capacitors each shunted by a foil capacitor.

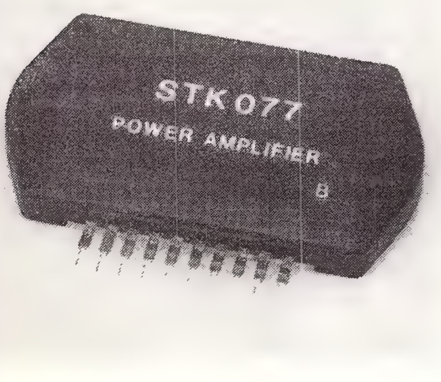
When a mains transformer with 2 × 18 V secondary is used, the direct output voltage under no-load conditions is of the order of 25 V, falling to about 22 V when a normal load is connected. A 1 A transformer can be used for output powers up to 20 W.

More power

With a ± 20 V power supply, the STK077 provides 20 watts into 8 ohms, or 30 watts into 4 ohms. In the latter case, both the third harmonic distortion and the current consumption are somewhat higher than in the former. If you want higher power, one of the series STK078...STK083 may be used: the printed circuit board remains unchanged, but it is, of course, necessary to use an appropriate mains transformer and higher rated electrolytic capacitors. Data for these are given in table 2.

Practical tips

The mains transformer may have a single centre-tapped secondary or two separate windings. In the latter case, proceed as follows: connect one of the terminals of secondary 1 with one of secondary 2 and measure the a.c. voltage between the two free terminals. If this is 0 V, the terminals of ONE of the secondaries must be changed over so that across the free terminals an a.c. voltage of twice the rating of one of the secondaries is measured. The interconnected terminals become the equivalent of the centre tap which is connected to earth as shown in figure 2.



1

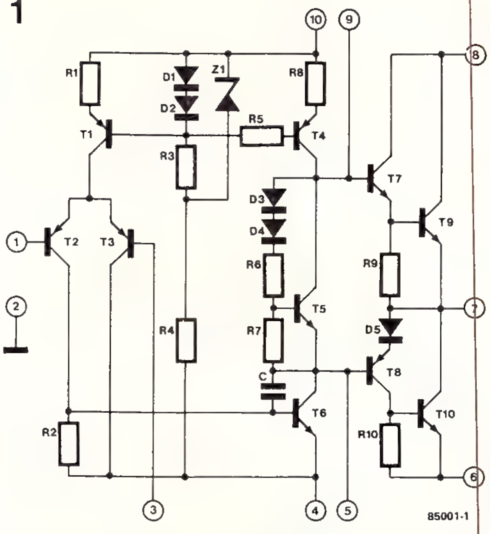


Figure 1. The circuit of the STK077. Note that the power transistors are connected in a quasi-complementary darlington arrangement.

2

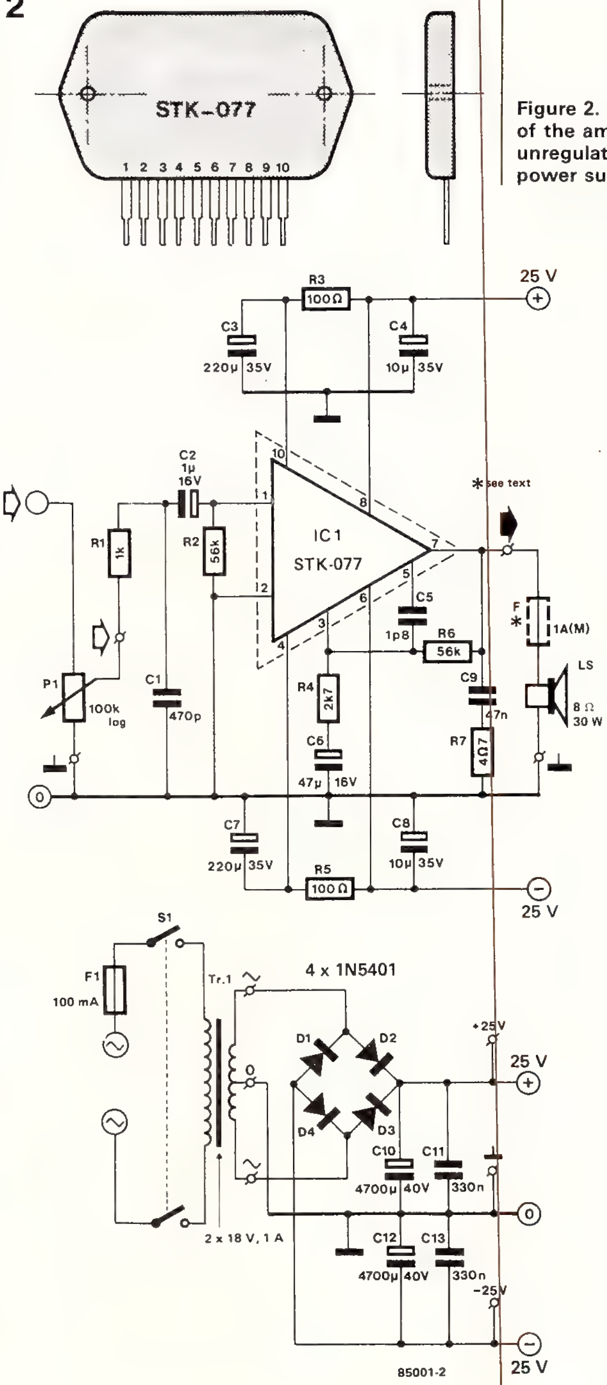


Figure 2. Circuit diagram of the amplifier and its unregulated, symmetrical power supply.

Parts list

Resistors:
R1 = 1 k
R2,R6 = 56 k
R3,R5 = 100 Ω
R4 = 2k7
R7 = 4Ω7
P1 = 100 k logarithmic potentiometer

Capacitors:
C1 = 470 p
C2 = 1 μ/16 V
C3,C7 = 220 μ/35 V
C4,C8 = 10 μ/35 V
C5 = 1p8
C6 = 47 μ/16 V
C9 = 47 n
C10,C12 = 4700 μ/40 V
C11,C13 = 330 n

Semiconductors:
D1 . . . D4 = 1N5401
IC1 = STK077 (or STK078 . . . STK083)

Miscellaneous:
S1 = DPST mains switch
Tr1 = mains transformer, secondary 2 × 18 V/1 A
F1 = fuse, 100 mA, slow blow
F2 = 1 A (8 Ω loudspeaker) or 1.6 A (4 Ω loudspeaker) slow blow (2 seconds)
Heat sink — temperature rise 1.7 K/W
Printed circuit board 85001

3

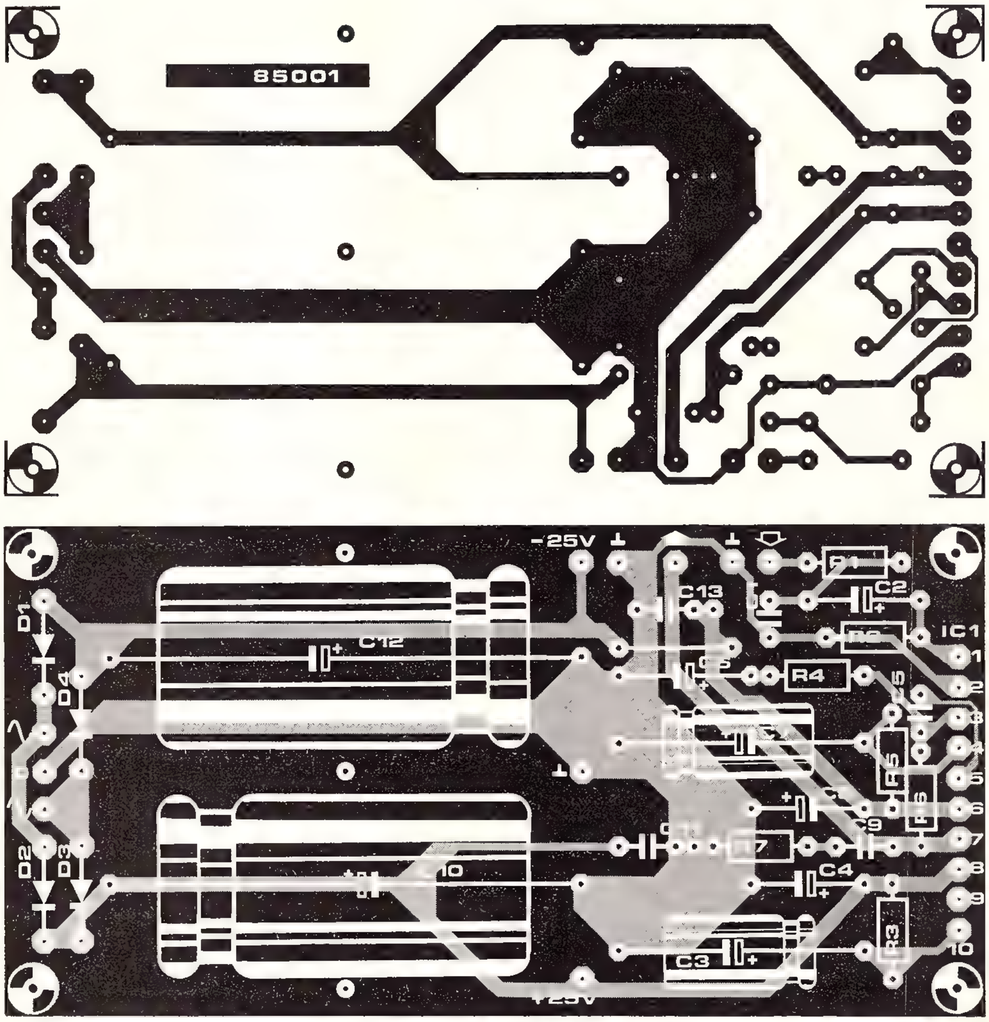


Figure 3. The printed circuit board is not only for use with the STK077 but also with other members of the family, STK078 . . . STK083, which give output powers of not less than 24 . . . 40 watt into 8 ohms, depending on which member is used.

Failure of one of the power lines during operation of the amplifier would destroy the IC. It is, therefore, vital to ensure that both power lines are connected properly at all times. Furthermore, under no circumstances should either the positive or the negative line be protected by a fuse. It is, of course, also important that the voltages across the two secondaries as well as capacitors C10 and C12 are identical.

The value of the thermal rating of the heat sink stated in the parts list and table 2 applies to the amplifier being driven hard. If the amplifier is intended for domestic (music) use only, the value may be

Table 1

Supply voltage, U_b — maximum	± 32 volts
— recommended	± 22 volts
Case temperature — maximum	85°C
Short-circuit duration — maximum	2 seconds
Load resistance — recommended	8 ohms
— minimum	4 ohms
Quiescent current — maximum	100 mA
— typical	50 mA
Power into 8 ohms — minimum*	20 watts
Bandwidth — at 1 W into 8 Ω	10 Hz . . . 100 kHz
— at 20 W into 8 Ω	10 Hz . . . 30 kHz
Output direct voltage — maximum	±70 mV
Input voltage (rms) — for 20 W into 8 Ω	600 mV
— for 30 W into 4 Ω	500 mV
Input impedance	50 kilohms
Current consumption — at 20 W into 8 Ω	1 A
— at 30 w into 4 Ω	1.5 A

* in range 20 Hz . . . 20 kHz, THD = 0.3%, U_b = ± 22 V

Table 1. Brief technical characteristics of the STK077.

somewhat lower. It may be useful to drill out the fixing holes in the heat sink slightly to avoid mechanical stress during its installation. The use of silicone heat transferring grease is strongly recommended.

If the amplifier is used for mono applications, a fuse may be fitted in the loudspeaker lead: this is shown in dashed lines in figure 2. The fuse should be of the medium-slow (about 2 seconds) type. Values for use with other ICs in the series are given in table 2.

The heat sink and printed circuit board should be fixed to a chassis with the aid of an aluminium angle piece as shown in figure 4, since the terminals of the IC cannot support the PCB.

As always in a.f. amplifiers, the wiring layout should be thought out carefully. On the premiss that any wires may cause problems, we reduced the amount of wiring by designing the power supply and the amplifier on one PCB. The only wires consequently required are three to the mains transformer, two to the loudspeaker, and a screened one for the input signal.

If two amplifiers are built for stereo applications, it is possible to use one mains transformer of twice the rating stated in the parts list. Separate power lines should then be connected to each of the PCBs. Separate earth return lines for each loudspeaker are also required: this means that each PCB is connected to the appropriate loudspeaker by a two-core cable.

If you want to use a 4-ohm loudspeaker, the mains transformer should be capable of providing a secondary current of 1.5 A: alternatively, a transformer with lower secondary voltage (2 × 15 . . . 16 V) may be used. The heat sink should also be adapted to the higher dissipation, for instance, 1.5 K/W instead of 1.7 K/W. The only other difference between the 4-ohm and 8-ohm versions is that the former has a slightly higher third harmonic distortion (THD) factor than the latter, as shown in figure 5. ◼

Table 2

		STK078	STK080	STK082	STK083
Supply voltage — max.	V	± 35	± 39	± 43	± 46
— recommended	V	± 25	± 27	± 30	± 32
Load resistance — recommended	Ω	8	8	8	8
Output power into 8 Ω — minimum	W	24	30	35	40
Secondary transformer voltage — recommended	V	2 × 20	2 × 22	2 × 25	2 × 27
Transformer rating — recommended	VA	≧50	≧60	≧75	≧90
Rating of electrolytic capacitors (C3,C4,C7,C8,C10,C12)	V	35/40	≧50	≧50	≧50
Fuse rating (8-ohm loudspeaker)	A	1.2	1.6	1.6	2
Heat sink — temperature rise	K/W	≦1.5	≦1.4	≦1.2	≦1

Table 2. Variations in ratings if higher power ICs from the STK series are used.

4

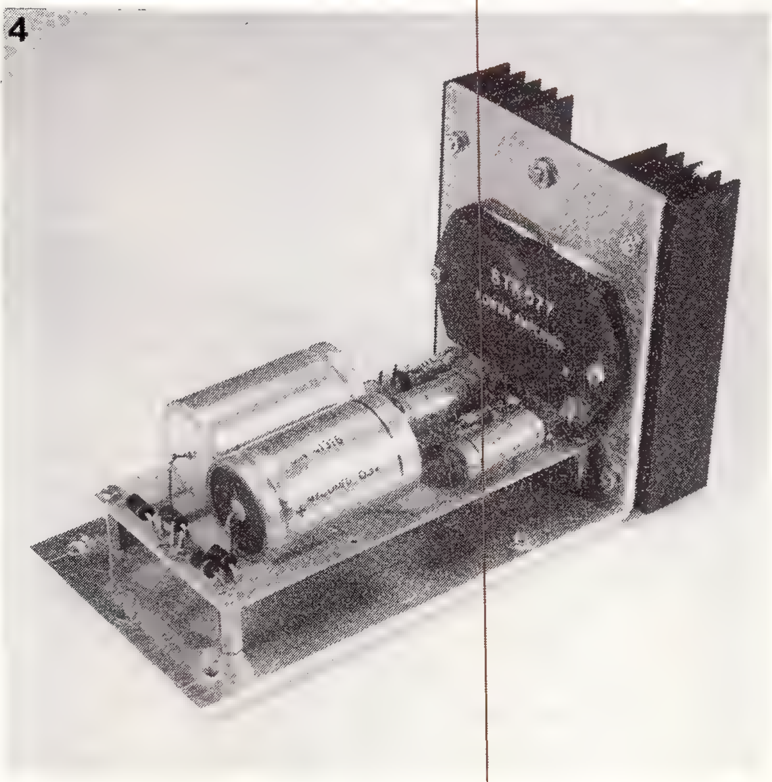


Figure 4. To avoid mechanical strain on the IC terminals, the printed circuit board, heat sink, and IC should be fitted together as shown.

5

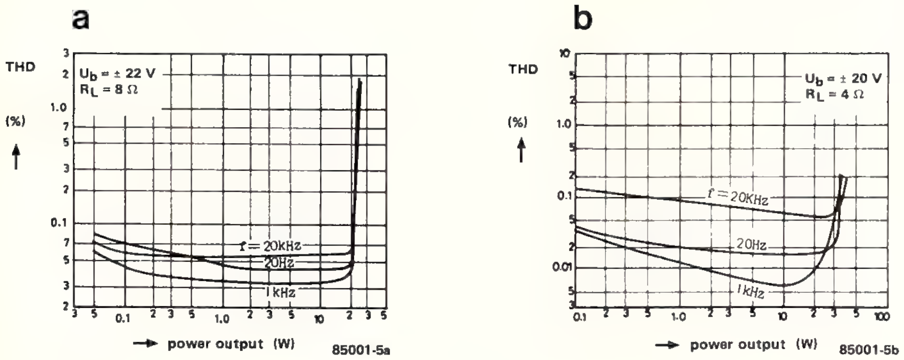


Figure 5. Third harmonic distortion vs output power in the STK077: in 5a with 8-ohm load and ± 22 V supply; in 5b with 4-ohm load and ±20 V supply.

Whenever two (or more) large programs must exist at the same time in a 6502's memory there is bound to be a conflict as regards page 0 and the stack (page 1). The situation could arise if a BASIC interpreter and a DOS (disk operating system), or both of these and a video handler, are being used simultaneously. One of the accepted methods of solving this problem involves reserving two areas in random access memory where these pages are 'duplicated', giving, for example, E000. . . E0FF for page 0 and E100. . . E1FF for the stack. Every time the computer changes from one program to the other the contents of these areas of RAM are swapped with the appropriate contents of pages 0 and 1. This removes any possibility of corrupting the pointers on page zero or the contents of the stack.

JSR SWAP

software to interchange pages 0 and 1 in a 6502-based system

One of the notable characteristics of the 6502 microprocessor is the way it uses pages 0 and 1. The 256 bytes from 0000HEX to 00FFHEX can be addressed using commands specific to this zone. This is known as page zero addressing; the most significant address byte is not specified as it is implicit in the operation code. The same 256 bytes can be used as 16-bit pointers for indirect indexed addressing of the rest of the memory. The 256 bytes from 0100HEX to 01FFHEX form the 6502's stack. This is a register generated by the processor itself to enable it to store certain information. It operates on the principle of 'last in first out' so the processor can only work with the last item stored on the stack. An internal stack pointer continually indicates the address of this last item.

It is obvious that the slightest careless change of the parameters saved on these two pages will upset the operation of a program that is being run — usually with no possibility of correcting the error.

When two programs are run in parallel it is essential that they do not destroy each other's page 0 and 1 parameters. This is an extra worry for the programmer, particularly as it can be an insoluble problem. As soon as the programs that are being run reach a certain size it is better to find a way to break away from the shackles governing the use of pages 0 and 1.

The routine proposed here is used to move the contents of page zero and page one to another area of RAM where they can be changed at will. At the same time the contents of the RAM area in question is transferred to pages 0 and 1. The name of the routine is SWAP, for obvious reasons.

Using this routine means that the programmer no longer has to worry about the contents of pages zero and one when leaving one program to carry out another. All he has to do is run the SWAP routine. Page zero (0000HEX. . . 00FFHEX) and page one (0100HEX. . . 01FFHEX) of the first program are saved at E000HEX. . . E1FFHEX, and the contents of pages 0 and 1 for the second program, which had been stored at E000HEX. . . E1FFHEX, are transferred to 0000HEX. . . 01FFHEX. When returning from the second to the first program the SWAP routine is again executed and the same procedure is carried out again to return the two pairs of pages zero and one to their original locations. The locations we have used to store pages 0 and 1 (E000HEX. . . E1FFHEX) can, of course, be changed to suit the system with which the SWAP routine is used, provided the area reserved is in random access memory. Similarly the SWAP routine itself must be run in RAM. A look at the last line of the listing will show why this is necessary. Indexing and swapping are the two procedures that make this routine possible so bear this in mind. ◾

Table 1. The processor leaves the SWAP routine (which it entered using JSR) not by RTS but by JSR! The return address is 'stacked' at the start of the routine, then corrected (return address = address left + 1) and then placed after the jump instruction identified by the label JMPINS.

```
                  ******
                  *SWAP*
                  ******


                  SWAP PAGE 0 AND PAGE 1 WITH E000 AND E100



E200              PZ     *      $0000  PAGE ZERO
E200              STACK  *      $0100  STACK AREA
E200              SPZ    *      $E000  SWAPPED PAGE ZERO
E200              SSTACK *      $E100  SWAPPED STACK AREA



E200 18           SWAP   CLC
E201 68                  PLA
E202 69 01               ADCIM $01     PUT RETURN ADDRESS
E204 8D 2C E2            STA   JMPINS +01 JUST BEHIND A JUMP OP-CODE
E207 68                  PLA
E208 AA                  TAX
E209 90 01               BCC   SW
E20B E8                  INX

E20C 8E 2D E2     SW     STX   JMPINS +02
E20F A2 00               LDXIM $00     RESET INDEX

E211 BD 00 01     SWAPST LDAX  STACK  GET BYTE FROM PAGE 1
E214 BC 00 E1            LDYX  SSTACK GET BYTE FROM SWAP AREA
E217 9D 00 E1            STAX  SSTACK SAVE BYTE FROM PAGE 1 IN SWAP AREA
E21A 98                  TYA
E21B 9D 00 01            STAX  STACK  SAVE BYTE FROM SWAP AREA IN PAGE 1
E21E B5 00               LDAX  PZ     GET BYTE FROM PAGE 0
E220 BC 00 E0            LDYX  SPZ    GET BYTE FROM SWAP:AREA
E223 9D 00 E0            STAX  SPZ    SAVE BYTE FROM PAGE 0 IN SWAP AREA
E226 94 00               STYZX PZ     SAVE BYTE FROM SWAP AREA IN PAGE 0
E228 E8                  INX          BUMP THE OFFSET
E229 D0 E6               BNE   SWAPST NOT DONE, KEEP ON

E22B 4C FF FF     JMPINS JMP   $FFFF  SELF MODIFYING CODE!!!

```

missing link

anodizing aluminium

(September 1984, page 9-56)
We have been advised by a reader that caustic soda lye CAN be stored in glas bottles, provided they do not use a glass stopper: fitted with a screw plastic cap or rubber stopper they are perfectly satisfactory. If a glass stopper is used, carbon dioxide is gradually absorbed from the atmosphere (because the stopper is a poor seal) and the contents are eventually converted to sodium carbonate (washing soda). Furthermore, if caustic soda solution gets onto the ground glass of the glass stopper, this again is converted to sodium carbonate which can make the stopper quite unremovable in a matter of weeks.

elabyrinth

(March 1984, page 3-34)
The last address and data (800: FF) in the hexdump in table 1 should be deleted.

direct-coupled modem

(October 1984, page 10-48)
It appears that the missing link in our November issue is still not the complete solution to FF3 setting inadvertently on switch-on. A satisfactory solution is to connect a 470 pF capacitor between pins 7 and 13 of IC7 and to ensure that C21 in positions TELEPHONE and MODEM is connected to earth via one of the unused sections of switch S2.

funny bird

(summer circuits, page 7-68)
T1 is drawn erroneously as an NPN type, whereas it is, of course, a PNP type.

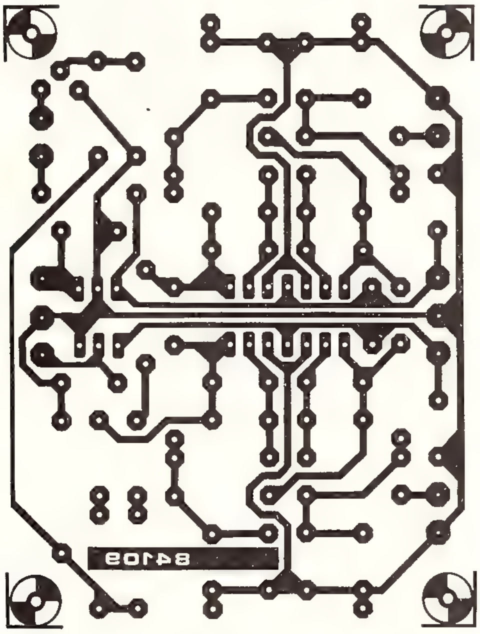
service

DANGER! Ultra-violet light is harmful to your eyes, so when working with a mercury vapour lamp, wear some form of *effective* eye protection.

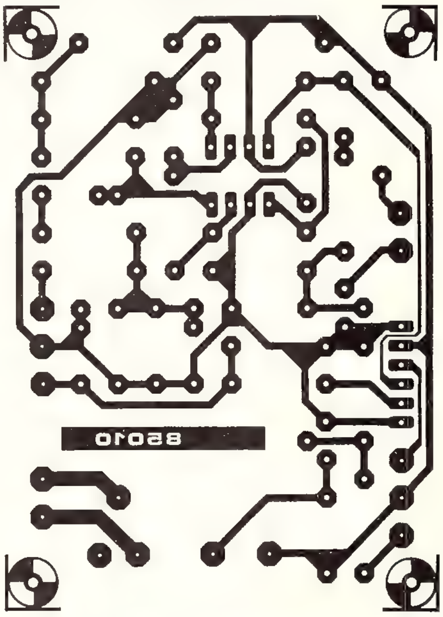
How to make your own PCBs
You require an aerosol of 'ISOdraft' transparentizer (distributors for the UK: Cannon & Wrin, 68 High St., Chislehurst, Kent, 01 467 0935, who will supply the name and address of your local stockist on request), a mercury vapour lamp, sodium hydroxide (caustic soda), ferric chloride, positive photo-sensitive board material (which can be either bought or home made by applying a film of photo-copying lacquer to normal board material).

- Wet the photo-sensitive (track) side of the board thoroughly with the transparant spray.
- Lay the layout cut from the relevant page of this magazine with its printed side onto the wet board. Remove any air bubbles by carefully 'ironing' the cut-out with some tissue paper.
- The whole can now be exposed to ultra-violet light.
- The exposure time is dependent upon the ultra-violet lamp used, the distance of the lamp from the board, and the photo-sensitive board. If you use a 300 watt UV lamp at a distance of about 40 cm from the board and a sheet of perspex, an exposure time of 4 . . . 8 minutes should normally be sufficient.
- After exposure, remove the layout sheet (which can be used again), and rinse the board thoroughly under running water.
- After the photo-sensitive film has been developed in a sodium hydroxide solution (about 9 grammes of caustic soda to one litre of water) for no more than 2½ . . . 3 mins at 20°C, the board can be etched in ferric chloride (500 grammes of $FeCl_3$ to one litre of water). Then rinse the board (and your hands!) thoroughly under running water. It is advisable to wear rubber or plastic gloves when working with caustic soda or ferric chloride solutions.
- Remove the photo-sensitive film from the copper tracks with wire wool and drill the holes.

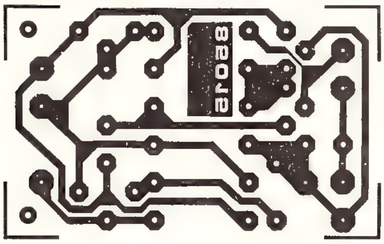
rumble detector



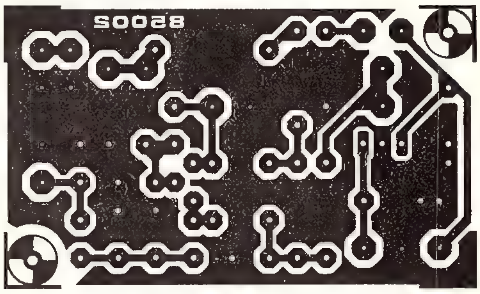
commodore cassette interface



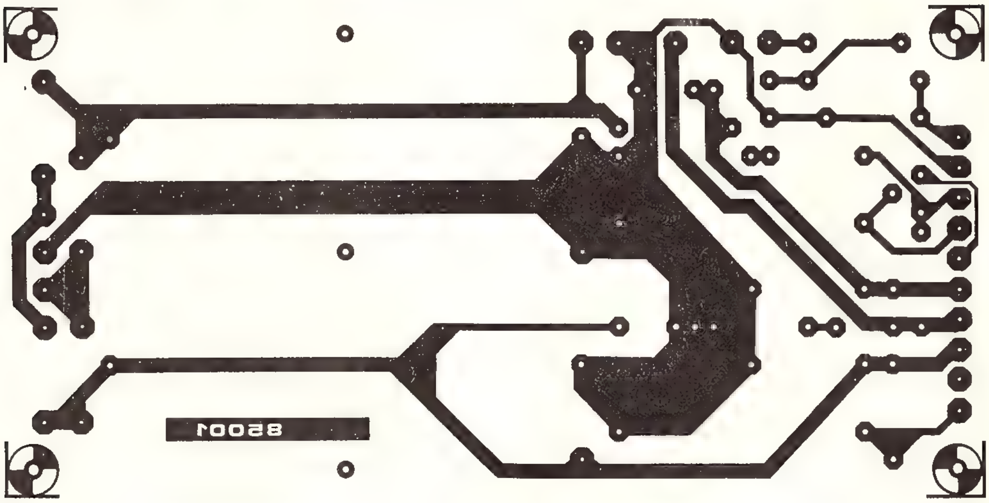
µP-controlled frequency meter (crystal oscillator)



vhf/uhf modulator



30 watt a.f. output stage



rumble detector

traces ultra-low frequency signals

Manufacturers of audio equipment are constantly competing against each other by improving the quality of their products. As a result even inexpensive amplifiers now have an extremely good frequency range, especially at low frequency. A lower cut-off point of a few hertz is certainly no exception and some actually go right down to d.c. This is all to the good as far as the quality of sound reproduction is concerned but it is also disadvantageous to a certain extent. Subsonic noise can be passed on to the loudspeakers and could even damage them. Murphy's Law of Acoustics comes into play here, of course: as this noise is subsonic it cannot be heard so how do you know that it is there? That can be very difficult . . . unless you build this rumble detector, which indicates, by means of a LED, when the subsonic part of an output signal becomes too great.

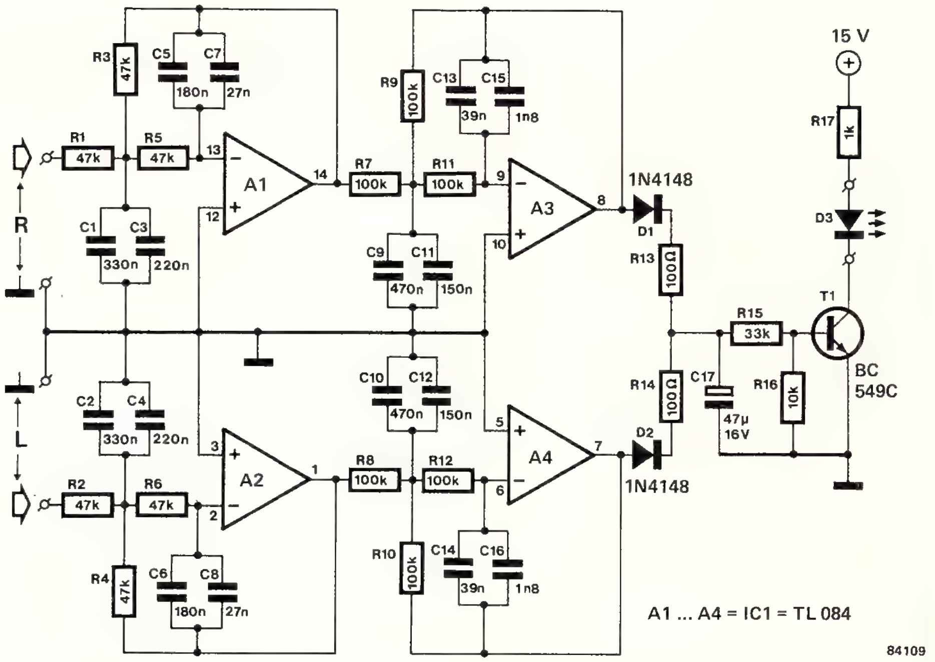
A very large low-frequency range is not necessarily a good thing. Often when a record is played at a reasonable volume the woofers occasionally 'strike' far further than the normal (acceptable) distance. This is usually due to undesirable distortion in the range of about 1 to 10 Hz. This phenomenon is limited only to record players; it is not noticed with compact disc players, radio tuners or tape players. The reason is that these last three have a high-pass filter of about 20 Hz fitted somewhere in the electronics or in the signal source. As far as this circuit is concerned, therefore, we are only interested in the record player.

For most people a record player is still the best source of high-quality sound reproduction. (The CD — compact disc — system may be technically better but is far less popular.) A lot of attention is paid to the MM (moving magnet) and MC (moving coil) inputs in 'reasonable-quality' amplifiers as the best results are possible by making use of these inputs. A good amplifier must nowadays have a frequency range right down to (practically) d.c. values — the merit of which we will not discuss — but when combined with a turntable this can make life difficult for loudspeakers. In order to remove the problem, however, we must first of all know how it arises.

Resonance and warped records

Most subsonic problems are caused by resonance in the turntable and pick-up arm. It all starts at the point where the arm pivots, its fulcrum in other words. The arm always pivots on some sort of elastic structure to allow the needle to move freely in the record grooves. Because there is a reaction between the mass of the arm and the elasticity of the mounting the assembly will have a resonant point. The frequency at which resonation occurs depends on the mass of the arm and the type of material on which it pivots. The extent of the resonance depends mainly on the inherent damping of the fulcrum and any damping intentionally built in. When choosing a cartridge to fit to an arm, or *vice versa*, care must be taken to be sure that the resonant frequency of the combination is not in the audible range. By the same token the resonant point must not be so low that it is triggered by warps in the record or by a vibrating floor. A resonant frequency of about 10 Hz is generally considered to be optimal, although

1



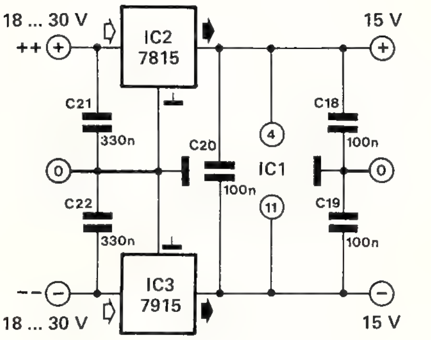


Figure 1. The filters in the rumble detector only pass frequencies below about 10 Hz. When this sort of subsonic noise is detected LED D1 lights to show that the signal is not very healthy for the woofers.

in practice a value between 5 and 15 Hz is acceptable. Unfortunately it is usually impossible to predict beforehand what the resonant frequency will be if a new arm or a new cartridge is bought. The only thing to do is to put your faith in an experienced audio shop. Most of us already have a certain combination of arm and cartridge and unless this gives terrible results we are not likely to change it.
The next problem is that of resonance in the chassis. Like the arm, the chassis will probably be mounted on springs or some other elastic assembly. Understandably, this also has a resonant point. In a well-designed turntable the resonant frequency will be about 2 to 4 Hz so that it cannot influence the resonance of the arm. The turntable is then relatively immune to sounds in the room (such as somebody walking around) and the arm can cope with warped records. If the chassis is not mounted on an elastic assembly there is one less resonant point to worry about, but this sort of turntable is more sensitive to outside interferance, like those same heavy footsteps and feedback from the loudspeakers.
If a record that is being played has a bump in it or is warped there is quite a likelihood that the pick-up arm will start to resonate. The result is a subsonic 'spike' that will be strengthened by the amplifier and fed through to the loudspeakers.
Even if the resonant point is well damped this will still happen. When somebody forgets to tread softly their heavy footfalls can cause the chassis to resonate, with the same result. The loudspeaker cones again thump out a note that nobody hears.
Clearly subsonic noise can very easily be produced by a turntable but it is not so easy to get rid of it. A good steep subsonic filter with a cut-off frequency of 15 to 20 Hz is ideal for this but such a filter is rarely included in an amplifier. If a filter is provided it is usually a rather imprecise affair that also removes some of the low frequency sounds which should be heard.
That does not seem to leave any options open, but the situation is not by any means hopeless. Provided the loudspeakers do not deflect too much the subsonic signals in themselves will cause no damage. That idea was the inspiration for this circuit, which monitors the subsonic content of the signal at an amplifier's loudspeaker outputs and lights a LED to signal when it becomes too great. The listener can then take appropriate measures. This may involve reducing the volume setting, examining the record for bumps or warps or mounting the turntable more firmly, for example. Whatever measures are needed the rumble detector will not effect the quality of the hi-fi system as it does not involve connecting anything in the signal line.

The circuit

The circuit has a very simple layout, consisting of only a low-pass filter for each channel (left and right) followed by a common LED for the indication. The filter roll-

2

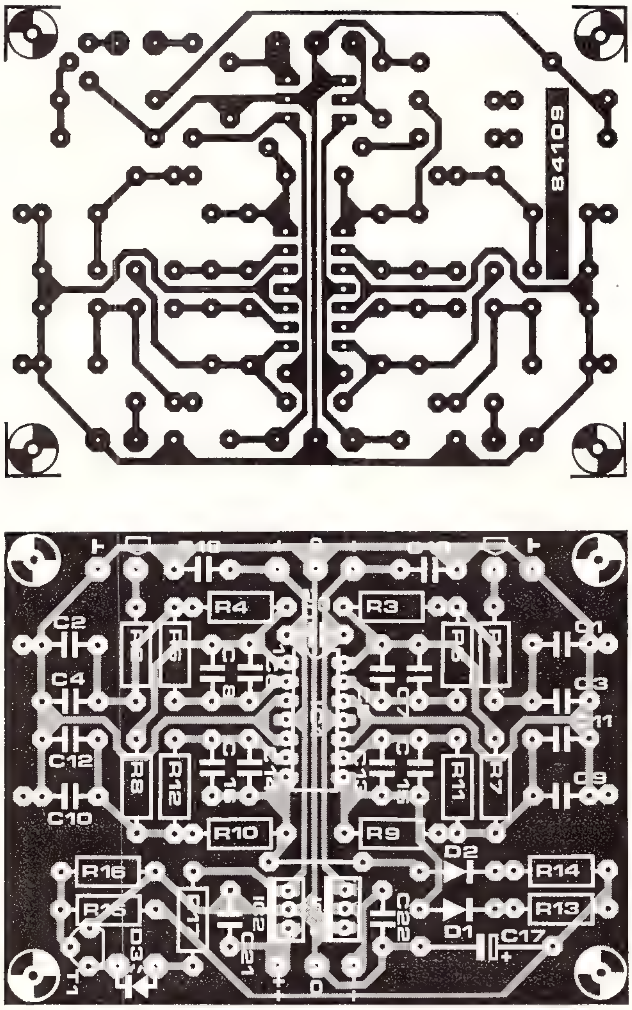


Figure 2. Voltage regulators are among the components found on the printed circuit board. If a + and −15 V supply can be tapped off the amplifier these two stabilisers are not needed.

off characteristics must be very steep to prevent the circuit from reacting to bass frequencies that are acceptable for the loudspeakers. This is the reason for using 24 dB/octave fourth-order Butterworth filters. (For detailed information about this and other types of filters refer to the article 'active crossover filter' published in the September 1984 issue of Elektor.) The actual multiple-feedback arrangement used for the filters makes them very stable and that is more than enough justification for their relative complexity. Each filter consists of two 12 dB/octave sections — A1/A3 and A2/A4. The component values chosen set the cut-off frequency to about 10 Hz so signals up to about 12 Hz can be detected. The output signals from the filters are half-wave rectified and then added together. The resultant signal charges capacitor C17 quickly. When the voltage on this capacitor reaches about 2.5 V transistor T1 conducts and causes the LED to light. After the subsonic signal has passed the LED remains lit for a certain time, dependent upon the d.c. voltage across C17.

Power for the circuit is provided via two voltage regulators, IC2 and IC3. The maximum input voltage to this power supply section is 30 V. This can be supplied by a small transformer (2 × 15 V/50 mA, for example) in combination with a bridge rectifier and two electrolytic capacitors (such as 470 μ/25 V). If the amplifier has a suitable symmetrical 15 V from which a tap-off can be taken the components marked with an asterisk in the parts list can be left out. The current consumption is a mere 20 mA so this will not prove an excessive burden to an amplifier.
The last thing to be done is to connect the circuit in parallel with the amplifier's loudspeaker outputs and the detector is ready for use.

Parts list

Resistors:
R1 . . . R6 = 47 k
R7 . . . R12 = 100 k
R13, R14 = 100 Ω
R15 = 33 k
R16 = 10 k
R17 = 1 k

Capacitors:
C1, C2, C21*, C22* = 330 n
C3, C4 = 220 n
C5, C6 = 180 n
C7, C8 = 27 n
C9, C10 = 470 n
C11, C12 = 150 n
C13, C14 = 39 n
C15, C16 = 1n8
C17 = 47 μ/16 V
C18 . . . C20 = 100 n

Semiconductors:
D1, D2 = 1N4148
D3 = LED, red
T1 = BC549C
IC1 = TL084
IC2* = 7815
IC3* = 7915

* = not needed if a symmetrical 15 V supply is used

Filter component values:

Butterworth 4th order (24dB/octave)

C5 + C7 = C6 + C8 = 1.85/6 π fR

C1 + C3 = C2 + C4 = 3/3.7 π fR

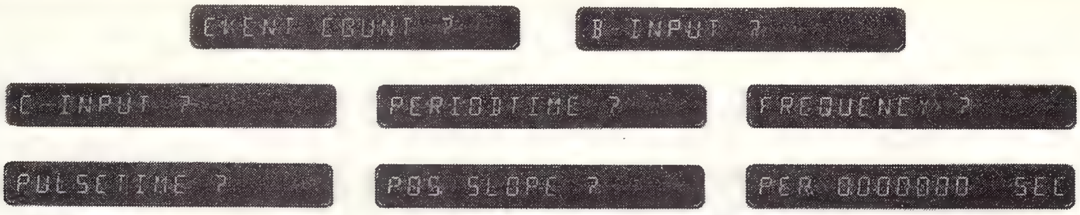
where R = R1 = R2 = R3 = R4 = R5 = R6

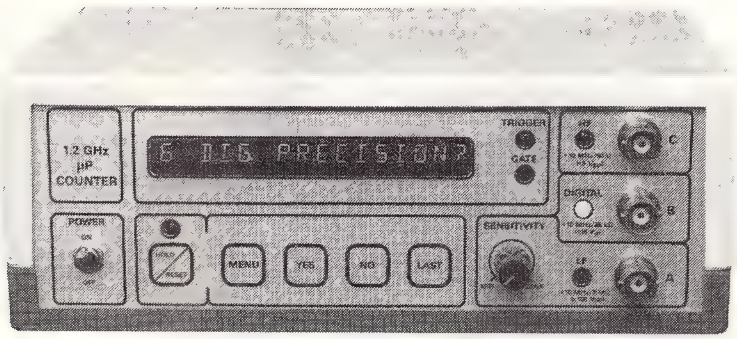
C13 + C15 = C14 + C16 = 0.77/6 π fR

C9 + C11 = C10 + C12 = 3/1.54 π fR

where R = R7 = R8 = R9 = R10 = R11 = R12

(All values are given in Ω, Hz and F)





microprocessor-controlled frequency counter

accurate, fast, user-friendly and practical

Superlatives simply have to be used when describing this frequency counter, but we will try not to let it get out of hand. We think it is only natural to feel a certain amount of pride, however. Here, at last, is a do-it-yourself frequency meter whose capabilities, features and ease of use are comparable to much more expensive ready-made (professional) equipment. This is a tribute to the Elektor designers who continually burned the midnight oil working on the design. Their advice to anybody who is thinking of building or buying a new frequency counter is to read this article and study the circuit diagram first. The chances are that this will be your next frequency meter.

Technical specifications:

- Frequency range: 0.01 Hz...1.2 GHz
- Period time measurement: 10 ns...100 s
- Pulse time measurement: 0.1 µs...100 s
- Event counter: 0...10^9 pulses
- User-selectable accuracy to 6 or 7 digits
- Measuring time for frequency measurements:
  - <0.2 s (6 digits) at f>20 Hz
  - <2 s (7 digits) at f>2.5 Hz
- Auto-ranging in all ranges
- 16-digit alphanumeric display with interactive operation
- Sensitivity:
  - input A: 10 mV_{rms} (2 MΩ)
  - input B: TTL, CMOS level (≈25 kΩ)
  - input C: 10 mV_{rms} (50 Ω)
  - with prescaler (>100 MHz): 100 mV_{rms} (50 Ω)

Many of our readers regard microprocessors as a scourge and something that has no place in a respectable 'electronic' circuit. Even having read the title on this page we hope that you have none the less read this far because we are now going to entreat you to bear with us and read the remainder of this article. This frequency counter does contain a microprocessor but for all intents and purposes it can be considered as just another 'black box'. Its use does, however, allow the design to be made more versatile and totally removes the need for a user's manual. Surely this is enough reason to turn a blind eye to the fact that this test instrument is 'cursed' with a microprocessor.

Let us look at the frequency counter's features one by one, starting with the auto-ranging possibility. In most meters this would have required a handful of components but in this design the 'calculator' does all the work.

The second point is the measuring method used, which was mentioned in the introductory article published in last month's issue. This so-called reciprocal measuring is only possible with the aid of a microprocessor as there are a lot of calculations to be made. The advantages of this method are maximum accuracy with a very short measuring time. It is used both for frequency and period measurements. A secondary benefit is that multi-position rotary switches are unnecessary as simple push buttons are sufficient.

If the circuit has a microprocessor anyway why not use an alphanumeric display? This, again, is easier to use. The frequency meter plays a game of question and answer with the user, who then makes a choice of the function desired by pressing a YES or a NO button. The display always shows what is being measured and what the units are: such as 'FREQ. 1.234567 KHZ' or 'PER. 8.61059 MSEC'. The price of the alphanumeric display and the associated controller IC is comparable to that of a set of good 7-segment displays plus drivers so cost does not enter into the equation.

Extensions and modifications can easily be included in this frequency counter; usually this is a matter of changing part of the software. This line of thought could lead to such things as an IEEE output or feeding in offset frequencies.

Finally, we draw your attention to the front panel foil with built-in low-pressure membrane switches. This gives the project a very professional appearance and simplifies fitting it into the case.

The measuring principle

If the frequency counter electronics are considered in the form of blocks a first rough sub-division leaves us with the three parts shown in figure 1: the microprocessor, the counter hardware and the display controller. The microprocessor section consists of a standard 6502 system with RAM (6116), EPROM (2732) and PIA (6821). The microprocessor works with the program stored in the EPROM and uses the RAM memory as a notepad and to store data. Communication with the other hardware is via the PIA (peripheral interface adapter). The display controller will be described in next month's issue so we will not deal with it now. The counter section makes up most of the circuit so we will look at that in detail, using block diagrams and timing charts, to give a better understanding of the operation of the whole circuit.
All the hardware is controlled by the microprocessor, with the aid of a pair of multiplexers to select the various measuring procedures. Each of the possibilities will be discussed in detail on the basis of a timing chart and a block diagram containing only the components appropriate to a particular function. The multiplexers are considered as straight-through links. First, however, we must see how all the measurements are made.

A lot of calculation

The article in the last month's issue (called 'part 0' because it was only an introduction, intended to whet your appetite) skimmed over the frequency counter's *modus operandi*. The microprocessor starts by setting the programmable divider to its lowest value. This means that the divider stops the measurement after a single period of the input signal. This is a test to prepare for the actual measurement so that the right division factor can be selected. The period time is worked out from the test and the processor then calculates which multiple of this period can be stored in the counter within the desired measuring time. Based on this the programmable divider factor, which is always a power of 2, is set. The measuring time is then defined by: $2^n \times T$, where T is the period time measured and n is the number selected for the divider. The number of period times that are counted is always a power of 2 so the measuring time for different frequencies can also vary by a factor of 2. As an example, assume an accuracy of 6 figures is selected. The gate time (measuring time) for this accuracy is at least 0.1 s. If the frequency to be measured is 5 kHz its period time will be $T = 200\ \mu s$. After the test measurement the microprocessor quickly makes the following calculations:
$2^n \times 200 \times 10^{-6} \geq 0.1$, so $2^n \geq 500$, giving
$n = 9$ and $2^n = 512$.
The last number is the factor for the programmable divider. The gate time is then:
$512 \times 200 \times 10^{-6} = 0.1024$ s.
If the frequency were 2.6 kHz the period would be: $T = 385\ \mu s$.
$2^n \times 385 \times 10^{-6} \geq 0.1$, whereby $2^n \geq 260$, which gives $n = 9$ and $2^n = 512$.
The same division factor is selected but the gate time is now:
$512 \times 385 \times 10^{-6} = 0.197$ s.
At 2.5 kHz the gate time does become less as the division factor is then $2^8 = 256$. The measuring time is given by:
$2^8 \times 400 \times 10^{-6} = 0.1024$ s.
When the 'real' measurement has been made the contents of the counter (X) is read out by the processor. The result is the gate time multiplied by 10^7 (the reference frequency of 10 MHz). The gate time is $2^n \times T$, so $X = 10^7 \times 2^n \times T$. Taking the example of f = 2.6 kHz again we see that $T = 1/2600$ s. This gives
$X = 10^7 \times 512 \times 1/2600 = 1969230$. Based on this figure and the division factor selected the microprocessor can calculate the frequency or period time, whichever the user has chosen.
$f = (10^7 \times 2^n)/X = 2.60000$ kHz

1

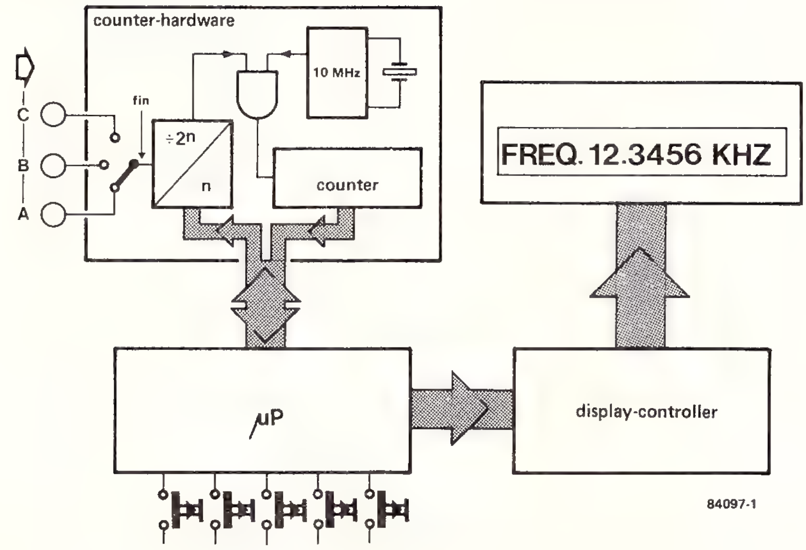


Figure 1. The block diagram for the frequency counter in vastly simplified form. The microprocessor controls virtually all the rest of the electronics.

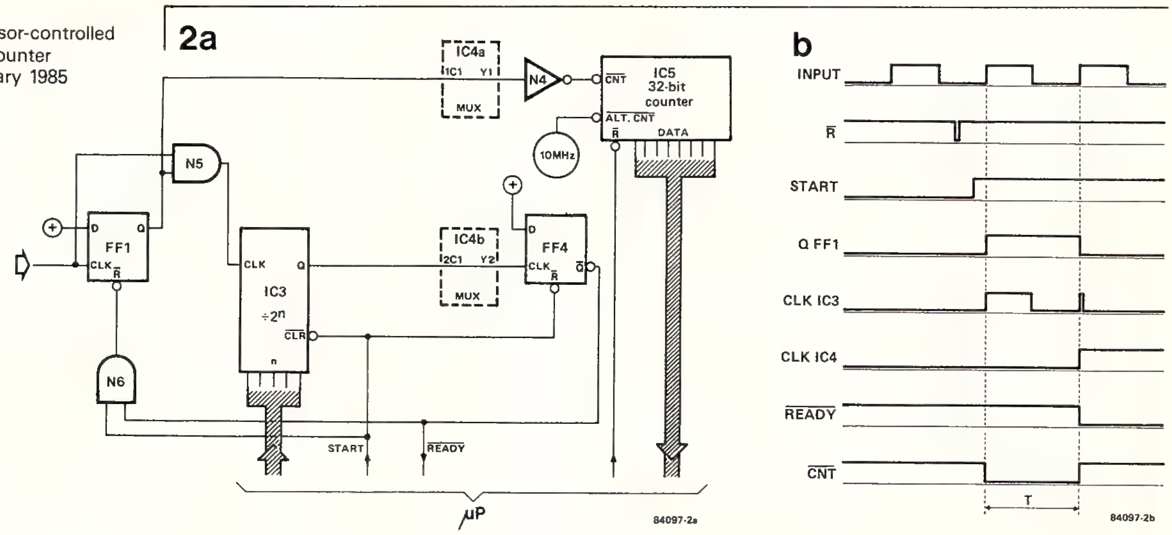


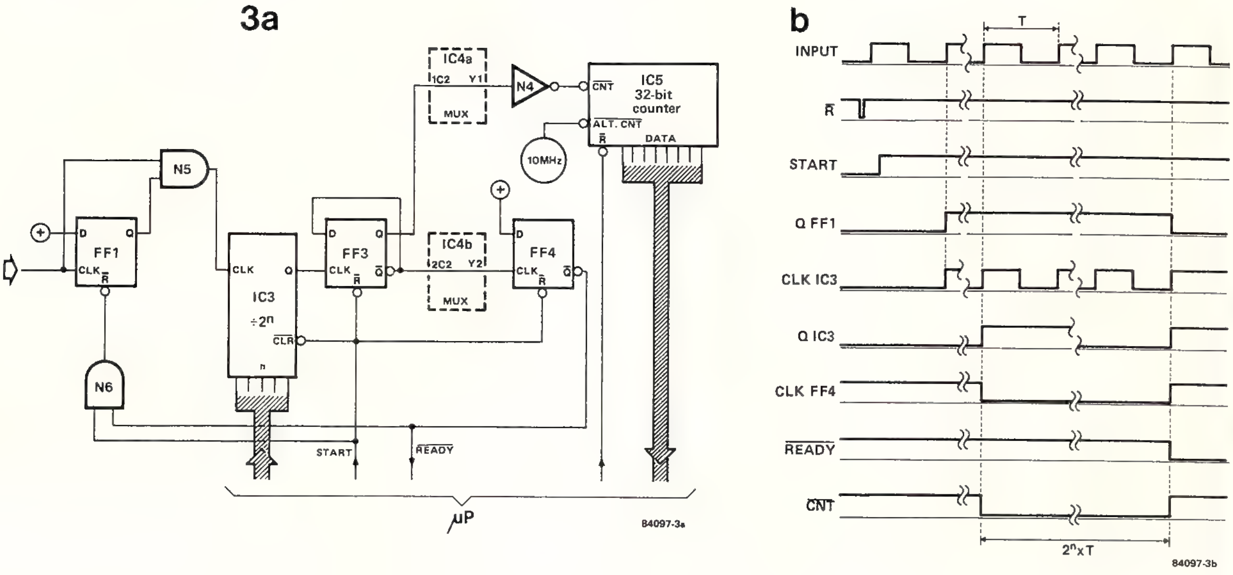
Figure 2. These are the components that play a part in test measurements for the frequency or period functions. The timing chart shows what happens to the relevant signals.

$T = X/(10^7 \times 2^n) = 384.615\ \mu s$
That, basically is how the frequency and period time are calculated. We will now look at the electronics needed to achieve this.

Frequency and period measurements

The set-up used for the frequency and period 'test' measurements is shown in figure 2a. The output signal of FF1 is fed to N4 and the Q output of IC3 is connected to FF4's clock input (via a multiplexer in each case). The sequence of events is shown in the timing chart (figure 2a). First the 32-bit counter is reset and the hardware is enabled by means of the START signal. The lowest possible division factor, 2^2, is selected for IC3. The next rising edge of the input signal makes FF1's Q output high so N5 can then feed the input signal to IC3. At the same time the $\overline{CNT}$ input of IC5 goes low so it starts counting 10 MHz pulses. The second rising edge of the input signal causes the Q output of IC3 to go high. (This output becomes '1' after the 2^{n-1}th rising edge if a division factor of 2^n is selected.) The $\overline{READY}$ line then becomes zero and resets FF1. This flip-flop's Q output then goes low with the result that IC5 stops counting. Even though IC3's division factor was set to 4 the output becomes high after a single input-signal period. The contents of IC5 is the result of counting 10 MHz pulses for one period and this figure is used to decide what division factor has to be set for the actual measurement.
For the actual measurement FF3's Q output is connected to N4 and the $\overline{Q}$ output to FF4's clock input (see figure 3a). The microprocessor then sets IC3 to the division factor that it has selected. The first rising edge after the START signal takes FF1's Q output high so N5 can then pass the input signal on to IC3. After 2^{n-1} rising edges the output of IC3 becomes '1'; this signal clocks FF3 and only then can IC5 start counting 10 MHz pulses. The next clock pulse for FF3 comes after exactly 2^n periods and FF3 then flips and stops counter IC5. At the same moment the $\overline{READY}$ line is taken low by FF4 to inform the processor that the measurement is completed. The counter's contents and IC3's division factor are then used to calculate the frequency or period. When

Figure 3. This arrangement is used for actual frequency or period measurements.



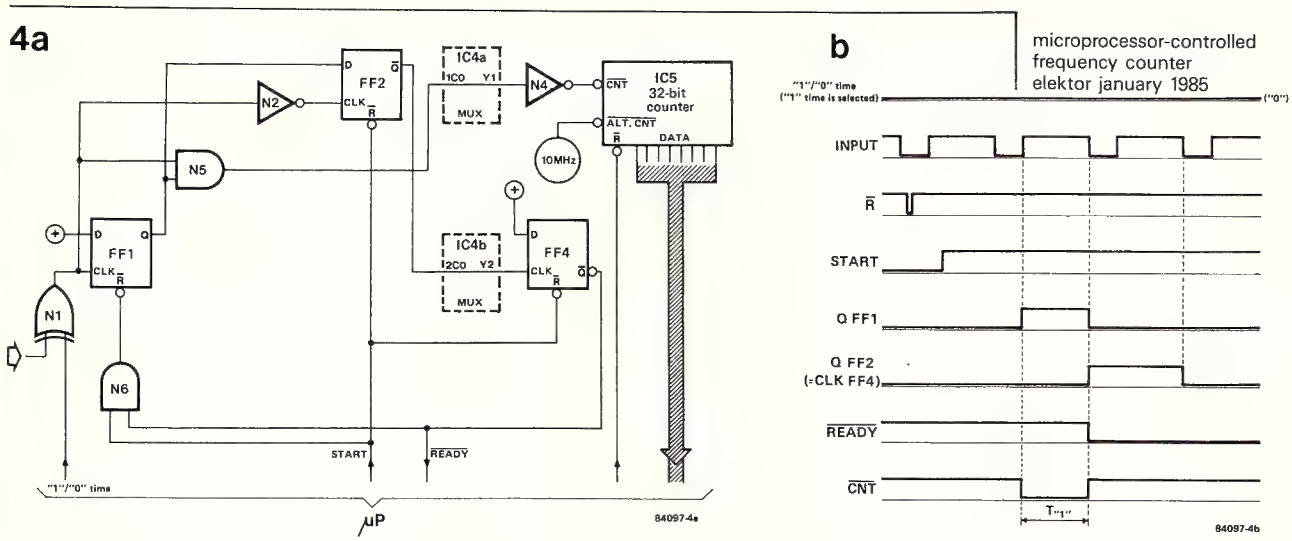


Figure 4. Pulse times are measured using the layout seen here and the appropriate signal changes are indicated.

this is done the result is passed to the display and the circuit is then ready to start the next measurement.

Pulse time

Pulse time is measured on the basis of the circuit seen in figure 4. The signal is input via an EXOR gate (N1) to enable the microprocessor to define whether the '1' or the '0' time is measured. The timing chart of figure 4b assumes that N1 does not invert the signal so the '1' time is measured. Once the hardware is STARTed the Q output of FF1 goes high with the input signal's first rising edge. The 32-bit counter is triggered via N5 and stops again at the input's falling edge. At the falling edge a clock pulse is fed to FF4 via FF2 and N2. The $\overline{\text{READY}}$ line (which goes low) then informs the processor that the measurement is complete and FF1 is also prevented from reacting to any more input signals. The contents of the counter is then equal to the pulse time in tenths of microseconds (as 10 MHz pulses were counted). This makes further calculations unnecessary.
The width of the pulses that are counted ($1/10^7 = 0.1$ µs) means that the resolution for pulse-time measurements is also 0.1 µs and the result displayed takes this into account. A number shown in microseconds on the display will never have more than one figure after the decimal point. The shorter the time measured the fewer figures will appear on the display.

Counting pulses

This is the easiest function so its block diagram (figure 5a) is also the most straightforward. Again N1 enables the microprocessor to choose whether the counter reacts to a rising or falling edge at the input. The input signal is then used to clock counter IC5 directly (so the 10 MHz reference frequency is no longer connected to the counter's $\overline{\text{ALT.CNT}}$ input). The microprocessor regularly examines the contents of the counter and outputs the result to the display.
The actual components used for each of the frequency counter's functions were given in each of the block diagrams so they can be more or less ignored in the actual circuit diagram. This is a distinct advantage as the circuit's complexity makes it difficult to see directly which parts relate to which function.

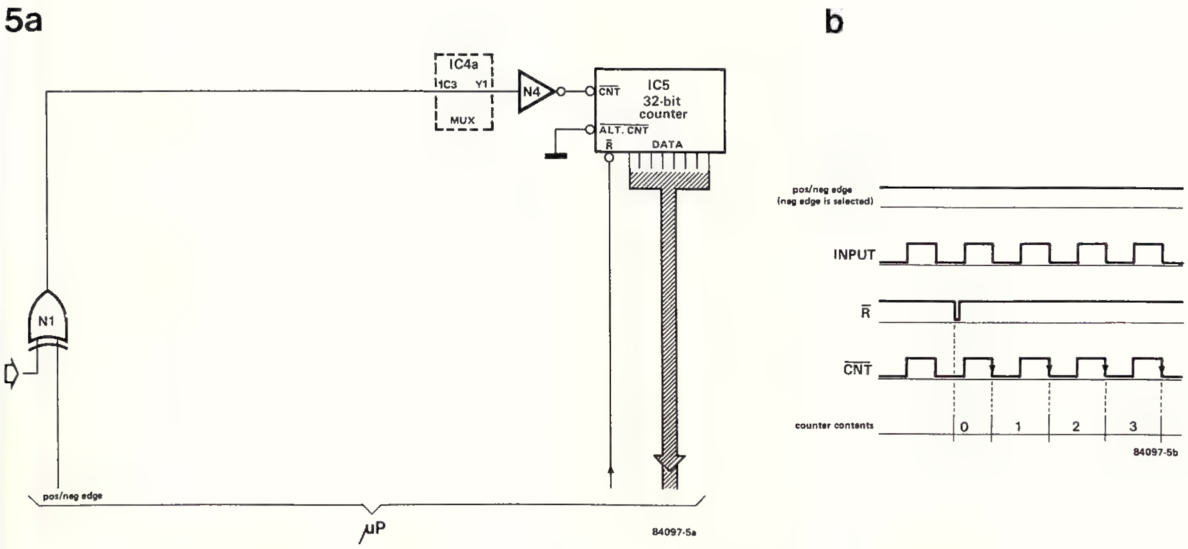


Figure 5. Very few components are needed for the event counter function, which uses this set-up.

The frequency counter circuit

The circuit diagram is divided into two parts: the processor section (figure 6a) and the counter hardware section (figure 6b). The power supply has been included in the drawing of figure 6a.

There is little need to say anything about the 6502, 2732 and 6116 in the processor system, especially as they are being treated as 'black boxes' in this circuit. The address decoder, IC8, and PIA, IC7, also belong to the processor section but they have been drawn in figure 6b because of the large number of connections between these ICs and the hardware section.

A break-down of the addressing ranges is given in the margin here as we must say something of the address decoding. The decoding method used is very wasteful of memory space but its great advantage is its simplicity as it requires only a single IC. Furthermore it works very well in this application, even leaving a block of 8 K free. The clock signal for the 6502 is taken from the 10 MHz reference via decade divider IC18. The circuit can cater for either a 2732 or 2764 EPROM (IC16) so there is room for software expansion. The system is reset on power-up by means of C5, R50 and N13.

Many of the components found in figure 6b are already known from the block diagrams. The display and its controller

Memory map

Address	Contents
$FFFF – $E000	EPROM (2732)
$DFFF – $C000	NOT USED
$BFFF – $A000	STPLED (= stopLED D5)
$9FFF – $8000	CNTRES (= counter reset LS7060)
$7FFF – $6000	SCRL (= scan counter reset LS7060)
$5FFF – $4000	CNTR (LS7060)
$3FFF – $2000	PIA (6821)
$1FFF – $0000	RAM (6116)

6a

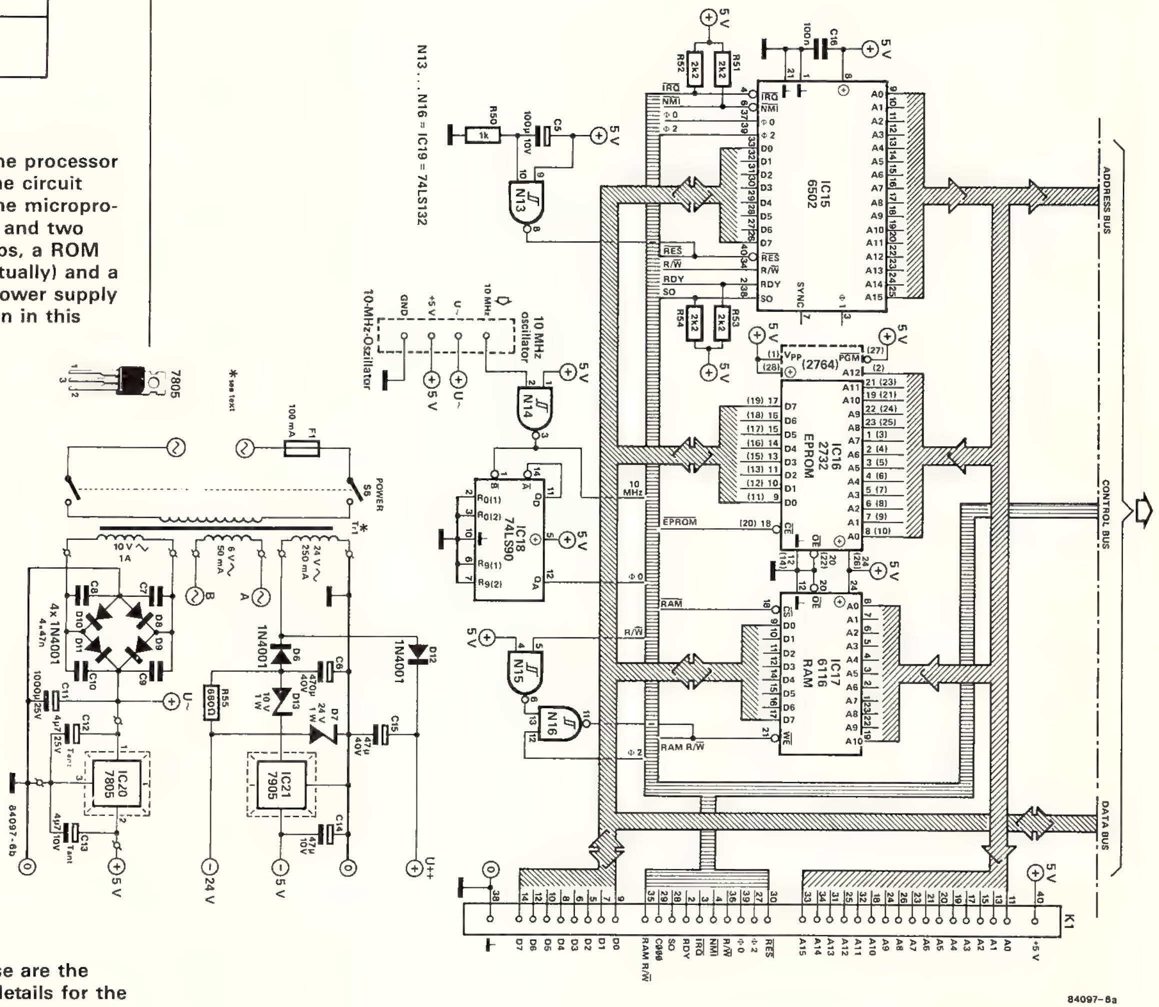


Figure 6a. The processor section of the circuit comprises the microprocessor itself and two memory chips, a ROM (EPROM, actually) and a RAM. The power supply is also shown in this diagram.

Table 1. These are the connection details for the three connectors in the frequency meter circuit.

Table 1

K1

Signal	Pin	Pin	Signal
NC	1	2	RDY
IRQ	3	4	NMI
D2	5	6	D3
D1	7	8	D4
D0	9	10	D5
A0	11	12	D6
A1	13	14	D7
A2	15	16	NC
A3	17	18	A10
A4	19	20	A5
A6	21	22	NC
A7	23	24	A9
A12	25	26	A8
Φ_2	27	28	SO
C000	29	30	RES
A13	31	32	A11
A15	33	34	A14
RAM R/W	35	36	R/W
NC	37	38	⊥
Φ0	39	40	+5 V

NC = not connected

K2

Signal	Pin	Pin	Signal
D14	1	2	D15
NC	3	4	D16
S3	5	6	S2
S4	7	8	S5
RES	9	10	D5
DATA	11	12	⊥
CLK	13	14	D2
S3/4/5	15	16	D1
NC	17	18	S1
−24 V	19	20	+5 V

K3

Signal	Pin	Pin	Signal
C/16	1	2	A
B	3	4	C/512
⊥	5	6	+5 V
−5 V	7	8	U++

84097-T1

6b

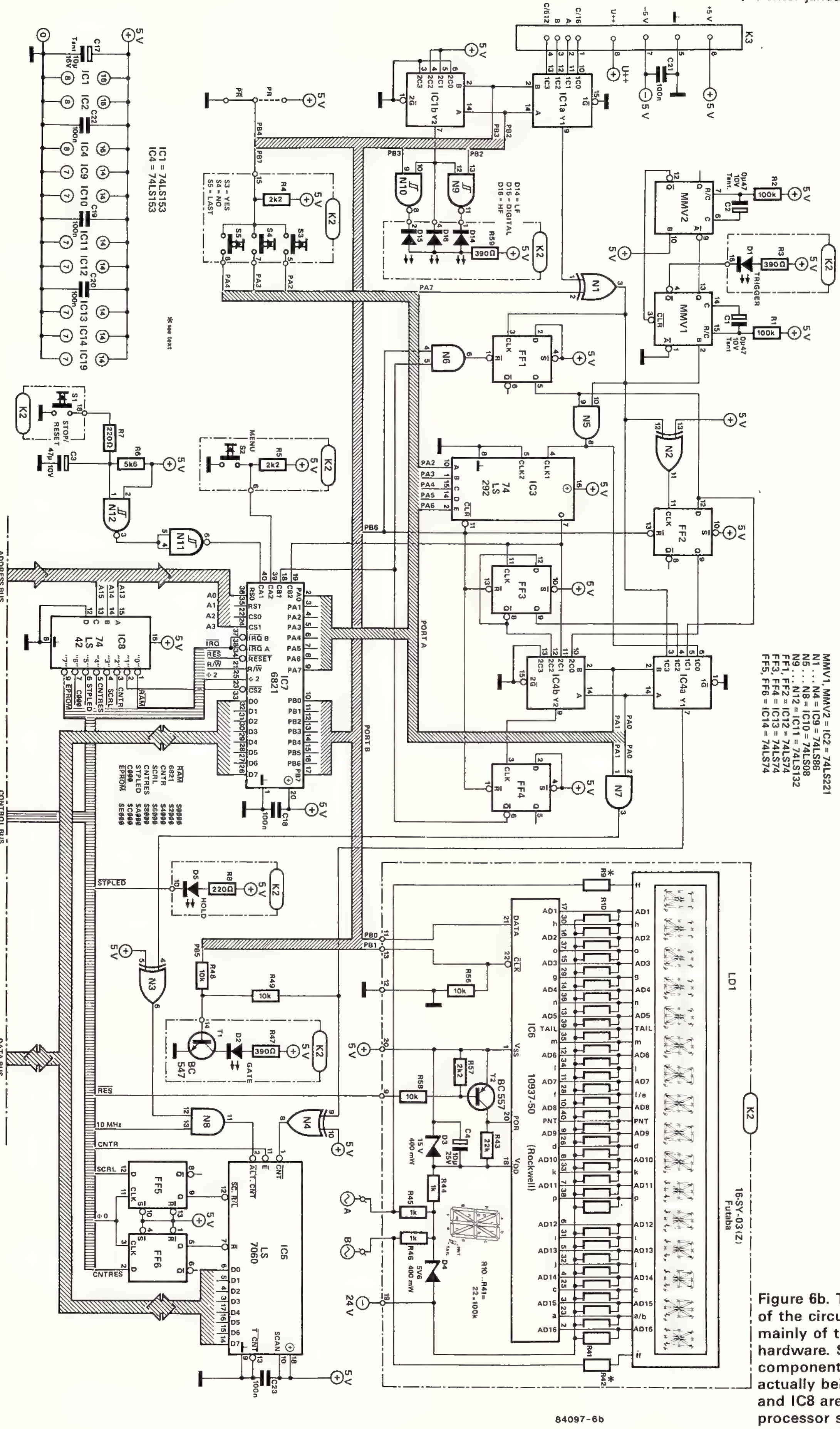


Figure 6b. The remainder of the circuit consists mainly of the counter hardware. Some of the components do not actually belong here: IC7 and IC8 are part of the processor section and the display with its controller is really a separate sub-section all of its own.

are also shown in this section but we will not deal with them until next month. All the 'boxed-in' parts of this diagram are found on the display printed circuit board. A number of points about this main circuit diagram must now be clarified.

At the input is the pair of four-bit multiplexers found in IC1. One of these multiplexers is used for choosing an input-A, B or C/16. If a prescaler is included in the circuit (this will be published next month with the input amplifier) the C/512 input can also be used. The prescaler is designed to handle the frequency range from 100 MHz up to 1.2 GHz. If link $\overline{\text{PR}}$ is fitted the circuit 'knows' that the prescaler is not fitted and the menu published last month applies. If, on the other hand, the prescaler is included points P and R must be linked with a wire bridge. An extra choice is then included in the menu. Choosing FREQUENCY and C-INPUT would normally be followed by the question 6 DIG. PRECISION? Instead the query displayed is: FREQ.<100 MHZ? If the reply is NO the counter then asks FREQ.>100 MHZ? Depending on the answer to this question the input multiplexer chooses input C/16 or C/512. The other section of IC1 drives LEDs D14. . .D16 via N9 and N10.

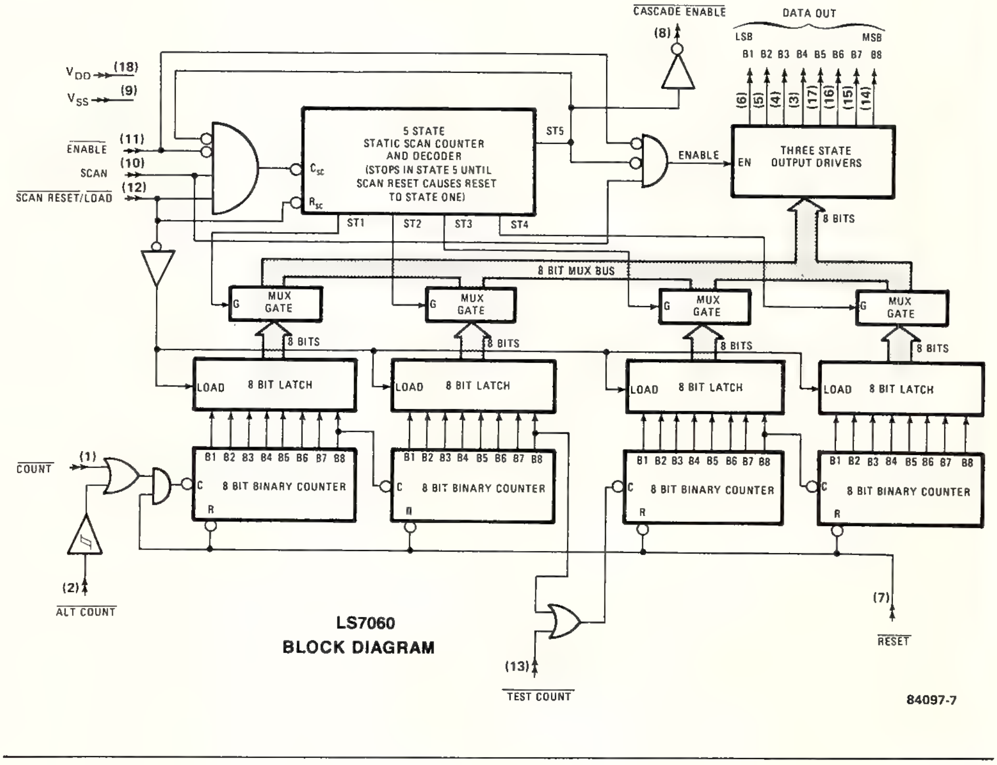
The TRIGGER LED, D1, is driven by monostables MMV1 and MMV2. This LED always flashes if there are active edges at the input. If the input signal frequency is low, 2 Hz, for example, D1 flashes with each active edge. At higher frequencies the LED simply flashes at a constant easily visible rate but there is then no distinction made between a frequency of 100 Hz and one of 10 MHz. This does not matter, of course, as the only intention of the LED is to show the user that the counter is being triggered.

The SCRL and CNTRES signals (scan reset/load and counter reset, both of which come from the address decoder) are synchronized to $\Phi 0$ by means of FF5 and FF6 to remove any spikes that might be present. This brings us to the heart of the circuit, the LS7060, whose internal layout is shown in figure 7. This is a dedicated counter IC containing a 32-bit binary counter complete with latch, multiplexer and three-state data outputs, all of which is microprocessor-bus compatible. To achieve the same result in TTL would require about 15 ICs so IC7's price is not as exorbitant as it might seem.

The contents of the 32-bit counter is stored in the latches as soon as the $\overline{\text{SCAN RESET/LOAD}}$ input goes from '0' to '1'. At the same time the scan counter is reset and the left-most multiplexer feeds the eight least significant bits to the data outputs. If an $\overline{\text{ENABLE}}$ pulse is now fed to the IC (CNTR goes low) these eight bits are placed on the data bus by the output drivers so that they can be read by the microprocessor. Should the $\overline{\text{E}}$ line return high the contents of the scan counter is increased so that the next eight bits are sent to the output drivers. The next $\overline{\text{E}}$ pulse places these eight bits on the data bus so after four enable (CNTR) pulses the processor has read all 32 bits. A logic zero of at least 1 μs on pin 37 of the IC $\overline{\text{RESET}}$s the 32-bit counter. This is taken care of by the CNTRES line in the circuit. The microprocessor generates the signal by simply placing the address for the CNTRES block momentarily on the address bus. In this way output '4' of address decoder IC8 is activated and this

Figure 7. The LS7060 is a dedicated counter IC, which means that it is quite expensive, but not in terms of what it provides.

7



signal is passed via FF6 to IC5's $\overline{\text{R}}$ input. The LS7060 IC also has two clock inputs, $\overline{\text{COUNT}}$ and $\overline{\text{ALT COUNT}}$. One of these is used as the clock input while the other serves as the enable input. We will not deal with the remaining pins of IC7 here as the $\overline{\text{TEST COUNT}}$, SCAN and $\overline{\text{CASCADE ENABLE}}$ are not used in our frequency counter circuit.

The gate LED, D2, indicates the time during which a measurement is made, and will light if there is a '1' on line PB5 or on output Y1 of IC4. We have already seen from the block diagrams that the Y1 output defines the 32-bit counter's measuring time for frequency and period measurements. When the event counter mode is selected the input is connected to Y1 and IC5 counts the incoming pulses. The circuit is then measuring continuously, even if a lot of the time is spent waiting for a pulse, so the gate LED should light continually. For this reason the processor places a '1' on the PB5 line. For pulse width measurements either the '1' or the '0' part of the signal is measured. A long pulse time (0.5 s, for example) can easily be seen on the LED but this is not so if the measured time is short (a repetition frequency of 1 kHz and a pulse time of 200 μs, for instance). A delay built into the software takes care of the problem. After taking a measurement the processor waits for about 200 ms before starting to measure again. The LED is driven by PB5 for a few milliseconds so that it flashes visibly. The software delay also works on the display, and in this way the last digit does not keep changing from one value to another (if, for instance, the pulse time is between 200.0 μs and 200.1 μs).

The gate LED makes one short and one long flash during frequency and period measurements of signals below about 100. . . 200 Hz. The short flash is the test, while the actual measurement is made during the long flash. The LED only flashes once when very low frequency signals are being measured as the maximum measuring time is then shorter than the signal's period. In this case the 'test' is the actual measurement.

Finally there is STPLED, D5, which indicates that the display is frozen and that no more measurements are being carried out. This LED is linked to output '5' of the address decoder and lights if the relevant memory block is addressed. The processor must then run through a loop in which the LED is constantly addressed. This is the only thing the processor has to do in the HOLD state. The display controller (IC6) ensures that the read-out remains fixed.

The display section is a completely independent part of the circuit. The ASCII data that must be displayed is sent to the controller IC by the processor. This information is then stored by IC6, which also takes care of driving the display. The processor only intervenes by transmitting new data if the displayed information has to be changed.

8

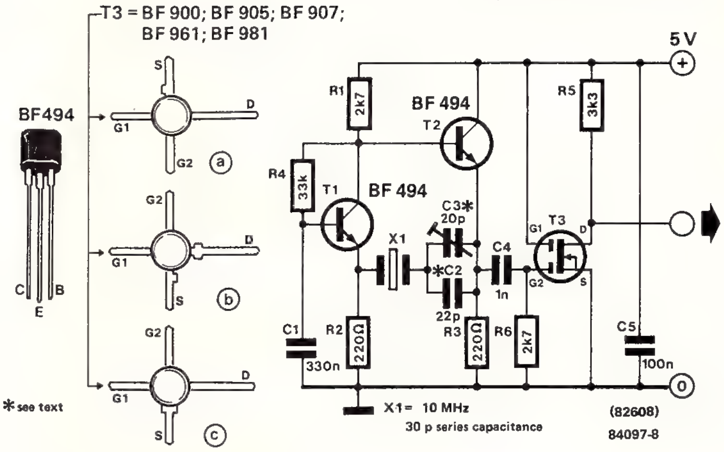


Figure 8. The circuit for the crystal oscillator is straightforward. Two transistors, T1 and T2, look after the low-impedance terminations for the crystal and a third one, T3, acts as a buffer.

The power supply section seen in figure 6a shows that several different voltages are needed. A heating voltage of 6 V a.c. is fed to the fluorescent display from one of Tr1's windings. The same transformer provides a zenered —24 V d.c. that is also used for the display. The remainder of the circuit is powered by the regulated 5 V line. Two more supply voltages (U++ and —5 V) are needed for the input stage. The diagram shows a single mains transformer with a total of three secondary windings but the same effect can be achieved with two or with three separate transformers.

The crystal oscillator

The crystal oscillator is a very important part of the frequency counter as it determines the accuracy to a large extent. The design used is shown in figure 8. The crystal is in series resonance as this guarantees quite good stability. Both sides of the crystal are terminated into a low impedance in order to prevent its Q factor from being unnecessarily reduced. The MOSFET at the output acts as a buffer between oscillator and frequency meter. This oscillator circuit has been fitted to a separate small printed circuit board, and there is a good reason for this.

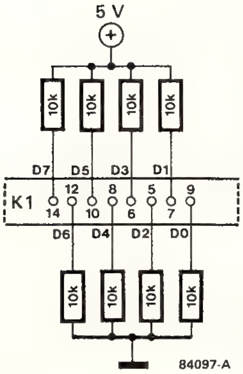
The oscillator shown is quite acceptable but a very precise, temperature-stable crystal oscillator is needed to achieve an accuracy of six or seven digits. A cautious estimate gives the oscillator of figure 8 a stability of at most 10 ppm (parts per million) in a temperature range of 15 to 35 °C. This means that the accuracy is far from optimal but it is good enough for the average hobbyist especially as the temperature within the case will settle down to a constant value within quite a short time. Some people will, of course, demand that measurements be accurate to six or seven digits. This can be achieved by substituting a special temperature-compensated oscillator in place of the one shown here. Such an oscillator will be expensive but it can easily be incorporated into this frequency counter.

A self-testing circuit

The frequency meter is made up of three printed circuit boards:
- the main board, which is double sided with through-plated holes
- the display board, and
- the crystal oscillator.

The first to be built is the crystal oscillator (if it is used). The series capacitance indicated in figure 8 is needed if the crystal has a capacitance of 30 pF. The capacitor and trimmer will have to be changed if different crystals are used. (Keep the trimmer as small as possible to prevent deterioration caused by its poor temperature stability.) The circuit is connected to a regulated supply and tested to see if the oscillator is supplying a 10 MHz signal. The output is probably distorted but this does not matter as it is caused by the capacitive load of the probe. A 10 MHz oscilloscope is needed during construction of the frequency counter so this is something you will have to get your hands on.

The next part to be tackled is the main printed circuit board, starting with the discrete components. Some of the capacitors and resistors (and one diode) must be mounted vertically. Sockets (preferably low-profile types) should be provided for all ICs, which must not be fitted yet. The eight lines indicated as K3 can be fitted with soldering pins. One of the voltage regulators, IC21, is connected to the board by means of three thick flexible leads about 10 or 11 inches long (roughly 25 cm). A pair of capacitors, C12 and C13, solder directly to the IC's pins. This regulator is not fitted with a heat sink but rather mounts straight onto the back panel of the Verobox. The heat generated is conducted through the metal plate and to aid this process silicone grease should be applied between voltage regulator and back panel. The photographs show where and how this IC must be fitted.



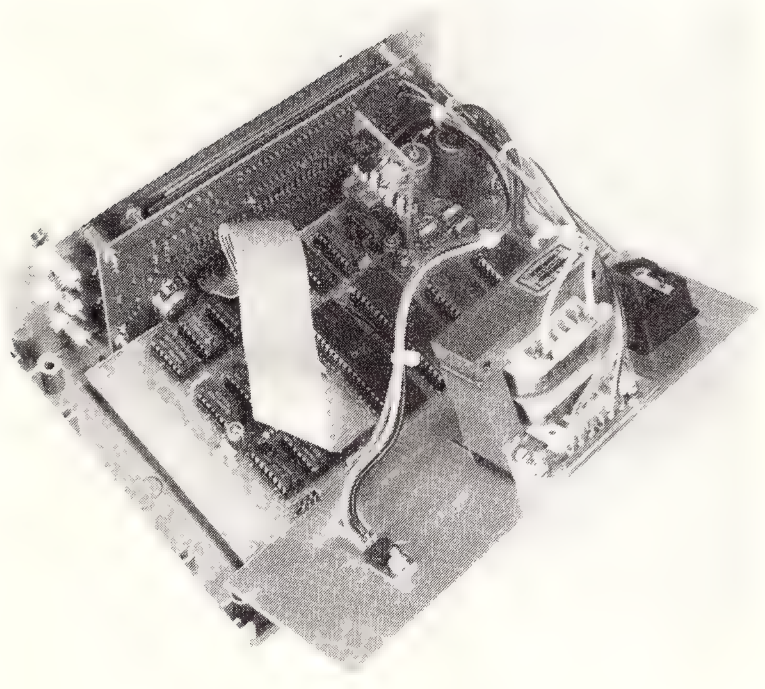
The mains transformer possibilities have already been mentioned but one point to note is that the case recommended does not leave a lot of room to play with. The fewer and the smaller the transformers the better they can be fitted into the available space. The 10 V winding is first soldered to the board and the output of IC20 is measured. This should be 5 V. The 24 V winding is now connected and the appropriate voltages measured: —5 V at pin 7 of K3 and —24 V at pin 19 of K2.

The oscillator board can now be mounted on the main board. Be particularly careful to prevent short circuits between the 5 V copper track and the ground connection to the oscillator board. The U∿ connection is not used by the Elektor oscillator. It provides an unregulated 9. . . 12 V d.c. for crystal oscillators that need more than the +5 V we have used.

Two of the ICs, IC18 and IC19, are now fitted to their sockets. A square wave of 1 MHz should be present at pin 12 of IC18. Hexadecimal number $AA must then be set on the data bus by means of eight 10 k resistors as shown in the margin here. The resistors are temporarily soldered to connector K1 and the 6502 can then be inserted into its socket. When the power is switched on again there should be a square wave of 250 kHz on address line A0, 125 kHz on A1, 62.5 kHz on A2, and so on down to 7.6 Hz on A15. This is easily checked with the oscilloscope as the period doubles each time. All address lines are available at connector K1. If the frequencies are not correct or if they are simply not present check pin 40 of IC15 ($\overline{\text{RES}}$), which should be '1'. Similarly $\overline{\text{NMI}}$ and $\overline{\text{IRQ}}$ should be '1'. On pin 39 (Φ2) there should be a (rounded) 1 MHz square wave. If there are signals on the address bus, but not the correct ones, it is possible that the 10 k resistors are not properly connected and that something other than $AA (10101010) is present on the data bus. A further, ever-present, possibility is that an address line may be shorted to another line.

The resistors are left where they are and IC8 and IC14 are fitted. Outputs '0'. . .'7' of IC8 should then in turn become logic zero for 16.4 ms. Pin 9 of IC14 must become '0' at the same time as pin 4 of IC8 and the same applies for pin 5 of IC14 and pin 5 of IC8. If this checks out the 10 k resistors can be removed.

Now we move on to the display section but first the heating voltage for the filament must be measured. Connect 330 Ω across the transformer's 6 V winding and measure the a.c. voltage across the resistor. It will usually be a little higher than 6 V. The series resistance needed to give a voltage drop of 5.8 V across the 330 Ω resistor can be calculated from the formula: $R = u \times 57 - 330$, where u is the voltage measured. Divide the result by two and use the nearest E12 or E24 value



9

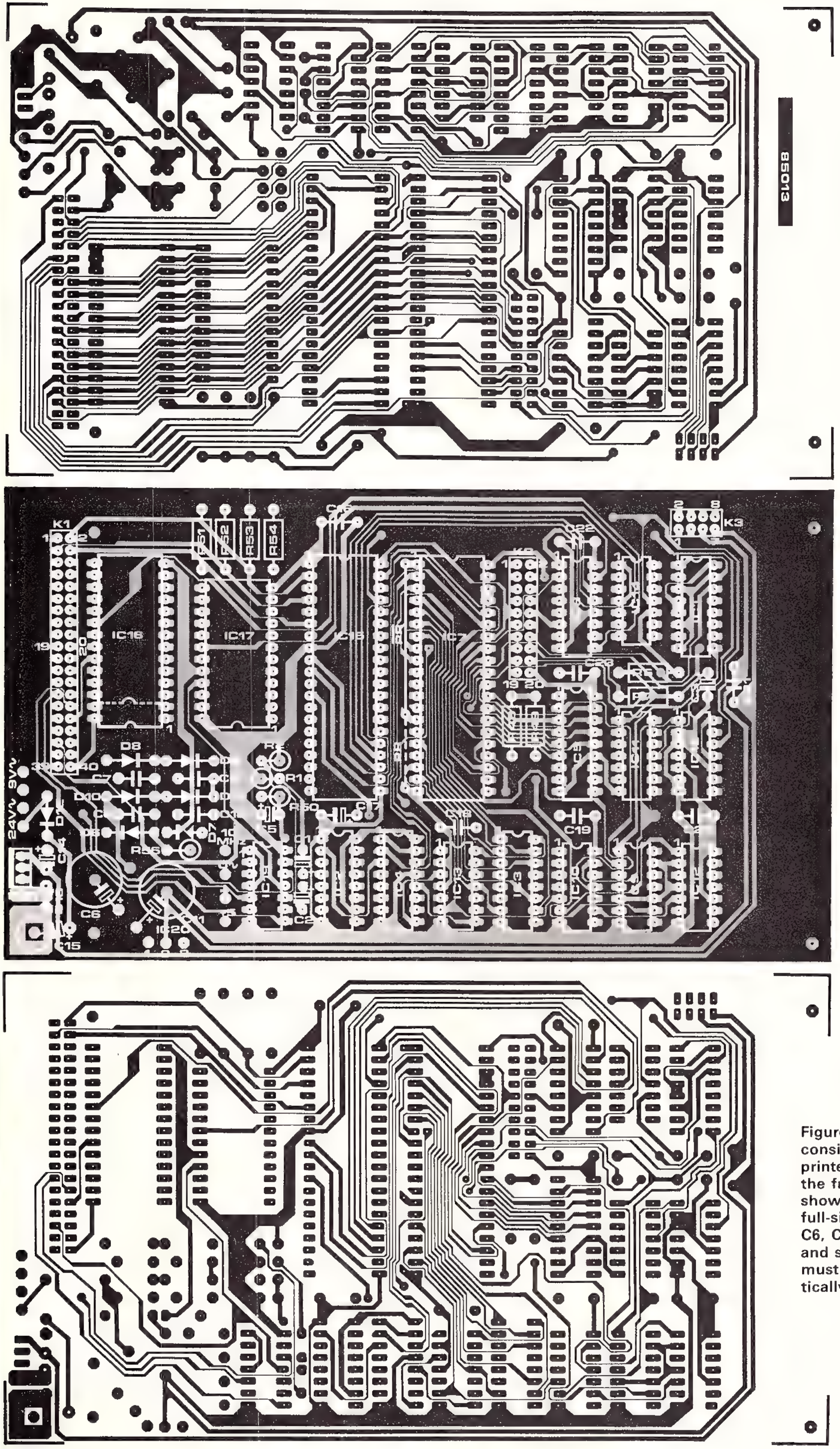


Figure 9. Due to space considerations the main printed circuit board for the frequency counter is shown here at 70% of full-size. Note that C3, C5, C6, C11, C14, C15, D13 and some of the resistors must be mounted vertically.

for R9 and R42 on the display board. The display board can now be assembled except that the display itself and IC6 should not yet be fitted. Do not use a socket for IC6. Note that the tops of the LEDs should extend 12 mm above the board and that transistor T2 is laid flat on top of the board. Use as thin a capacitor as possible for C4 or fit it on the reverse side of the printed circuit board. The

10

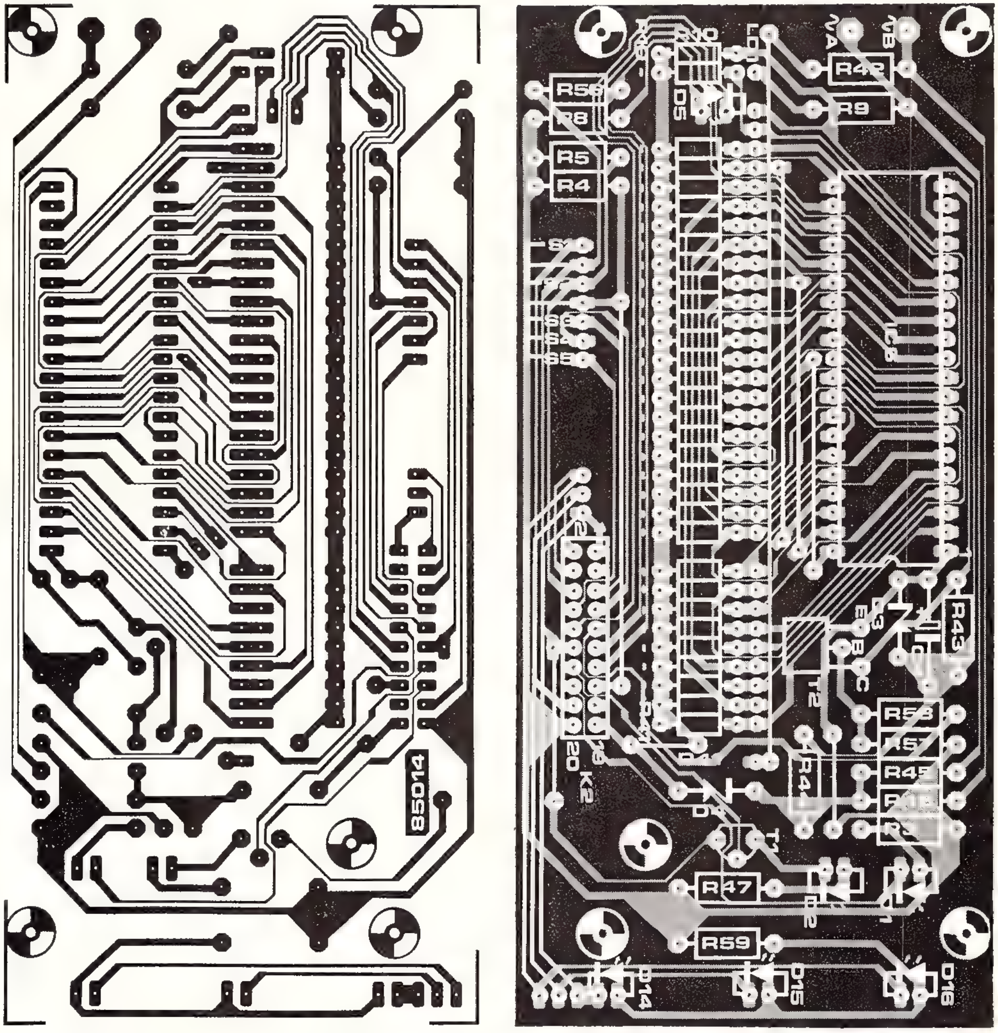


Figure 10. The display section is fitted on this printed circuit board. The 16-digit alphanumeric display is soldered straight onto the board and only bent back after testing is complete.

Parts list

— **Main board and display board**

Resistors:
R1, R2 = 100 k
R3, R47, R59 = 390 Ω
R4, R5, R51 . . . R54, R57 = 2k2
R6 = 5k6
R7, R8 = 220 Ω
R9, R42 = *
R10 . . . R41 = 100 k, 1/8 W
R43 = 22 k
R44 . . . R46, R50 = 1 k
R48, R49, R56, R58 = 10 k
R55 = 680 Ω

Capacitors:
C1, C2 = 0.47 μ/10 V Ta
C3, C14 = 47 μ/10 V
C4 = 10 μ/25 V
C5 = 100 μ/10 V
C6 = 470 μ/40 V
C7 . . . C10 = 47 n
C11 = 1000 μ/25 V
C12, C13 = 4.7 μ/25 V Ta
C15 = 47 μ/40 V
C16, C18 . . . C23 = 100 n
C17 = 10 μ/10 V Ta

Semiconductors:
D1 = LED, 5 mm yellow
D2, D5, D14 . . . D16 = LED, 5 mm red
D3 = 15 V/400 mW zener
D4 = 5V6/400 mW zener
D6, D8 . . . D12 = 1N4001
D7 = 24 V/1 W zener
D13 = 10 V/1 W zener
T1 = BC547
T2 = BC557
IC1, IC4 = 74LS153
IC2 = 74LS221
IC3 = 74LS292
IC5 = LS7060 *(LSI)*
IC6 = 10937-50 *(Rockwell — available from Regisbrook)*
IC7 = 6821
IC8 = 74LS42
IC9 = 74LS86
IC10 = 74LS08
IC11 = 74LS132
IC12 . . . IC14 = 74LS74
IC15 = 6502
IC16 = 2732
IC17 = 6116
IC18 = 74LS90
IC19 = 74LS132
IC20 = 7805
IC21 = 7905

Miscellaneous:
F1 = fuse, 100 mA slow blow
LD1 = Futaba 16-digit alphanumeric fluorescent display, type number 16-SY-03(Z) *(available from Regisbrook)*
S1 . . . S5 = membrane switch in front panel foil
S6 = miniature double-pole mains switch
TR1* = mains transformer(s) 6 V/≥50 mA, 10 . . . 12 V/≥800 mA) and 24 V/≥150 mA
heatsink for IC21
connector for cable from front panel foil (7-way right angled, 2.54 mm/0.1" centres)
Verobox no. 075-01411D (dimensions 205 × 140 × 75 mm)

front panel no. 84097-F

* = see text

cable from the membrane switches in the front panel clips into the connector between R4 and K2. A length of 20-way ribbon cable about 7 inches (17 cm) long is soldered directly into the holes for connector K2 on the reverse side of the display board. The other end of the cable is then soldered directly to the main board (do not use soldering pins at either end). The numbers linked by each wire in the cable must, of course, be the same on both boards.

With the power switched on the voltages on the display board can be checked. There should be +5 V at pin 1 of IC6 and —10 V on pin 18. The d.c. voltage on the common line for R9...R41 should be —24 V. Switch the power off and solder IC6 directly onto the board. The pins of the display are pushed through the board until they extend by about 1 mm and are then soldered. Do not bend the display parallel with the board yet; until testing is complete it is left standing straight out like this. Returning to the main board IC16, complete with its program, is inserted into its socket. Switch the power on again and then touch the $\overline{\text{NMI}}$ line (pin 4 of K1) to ground for an instant. The self-test program in the EPROM then starts. The first function of this program is to test if it is itself correctly stored in IC6. If it is stop LED D5 lights for about 1 s to show that all is in order. If the LED remains out the EPROM is probably incorrectly programmed or one of its pins is not making proper contact. This assumes, of course, that the LED is fitted properly and that the wiring between the two boards is also correct.

After D5 has lit up the power can be switched off to enable IC7 to be fitted into its socket. The power is turned on again and the '0' pulse is again applied to the $\overline{\text{NMI}}$ line. Each of connections PA0...PA7 then goes high for 1 s in turn so LEDs D2, D14, D15 and D16 start flashing (on for 1 s and off for 8 s). There is also a '1' running through lines PB0...PB6 (except for PB4). Provided the '1's keep running and the LEDs flashing the circuit is correct so far. Otherwise check IC7's socket to ensure that all the pins of the chip are inserted correctly. Next it is IC17's turn to be fitted. Substitute a wire bridge for S3 on the display board so that the circuit thinks that this push button is pressed continuously. Power is again applied to the circuit and the $\overline{\text{NMI}}$ line momentarily grounded. The gate LED should light for a short time. If this does not happen there is something wrong in (or with) the RAM. The gate LED may also fail to turn off and the stop LED may light and if this happens it indicates a problem, probably a programming error, in the EPROM.

It may be an advantage at this stage to see exactly what the test program does. If switch S3 is closed (or bridged) and $\overline{\text{NMI}}$ receives a short '0' pulse the program tests itself and lights the stop LED for about one second. The microprocessor then examines PB7. If this line is '1' the PIA is then tested but if it is '0' (as it is when S3 is bridged) the RAM test procedure is started. This involves copying the contents of the EPROM to the RAM and then comparing what is stored in both. Assuming this test gives a positive result the gate LED lights briefly. Immediately after this the EPROM is tested: all the bytes are summed and a checksum byte is added. The result must be $00. Any other result indicates one or more faults in the EPROM and the stop LED then lights. The power can now be switched off and the short circuit for S3 removed, as can the wire used to provide pulses to the $\overline{\text{NMI}}$ line. Connect the 6 V winding of the mains transformer to the display board. When the power is now switched on the display shows the text OVERFLOW, PLEASE RESET or FREQ. X.XXXXX HZ. This is an indication that the display board is correct. If nothing appears on the display the connections to the display board from the main board and from the transformer should be checked. Test also that the 6 V a.c. is present. Remove the power again and install the remaining ICs into the main printed circuit board. The cable from the front panel can also be plugged into its connector. (This cable is actually a thin plastic 'tail' with the wires from the front panel's switches embedded into it.) Treat the ICs carefully, especially the 74LS292 which is very sensitive.

Once again the power is applied to the circuit. The display should show FREQ. 0.000000 HZ. Press the menu button once and the NO button three times. The display is now EVENT COUNT? Press the YES button three times and the display will indicate TOTAL 0. Apply a square wave (about 1 Hz) at TTL level to pin 2 of K3 and measure if this signal is also present on pin 9 of IC1, pin 3 of IC9, pin 7 of IC4, pin 8 of IC9 and pin 1 of IC5. Both pin 6 of IC9 and pin 2 of IC5 should be zero.

If the circuit is working correctly each incoming pulse will be added to the total shown on the display. The trigger LED should also flash with each pulse and the gate LED should light continuously. If this does not happen the problem is almost certainly to be found in or around IC5.

All the frequency meter's functions should now operate properly. Doubting Thomases can check this by comparing signals at various points in the circuit with the appropriate timing charts.

Casing the circuit

Before any part of the circuit can be fitted into the case the necessary ventilation holes must be drilled in both upper and lower sections. Assuming the recommended type of box is used the main printed circuit board will fit snugly inside parallel to the bottom and can be fixed to the mounting bosses with self-tapping screws. An insulating ring must be placed under the bolt beside K1. The mounting boss at the front left-hand corner of the

11

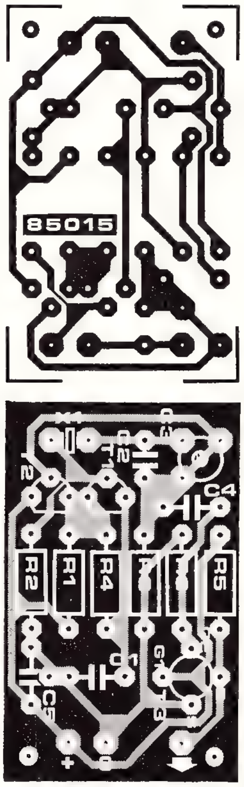


Figure 11. The small size of the printed circuit board for the crystal oscillator belies its importance. This is what makes the microprocessor tick.

Parts list

— Crystal oscillator

Resistors:
R1, R6 = 2k7
R2, R3 = 220 Ω
R4 = 33 k
R5 = 3k3

Capacitors:
C1 = 330 n
C2* = 22 p
C3* = 20 p trimmer
C4 = 1 n
C5 = 100 n

Semiconductors:
T1, T2 = BF494
T3 = BF900, BF905, BF907, BF961, BF981

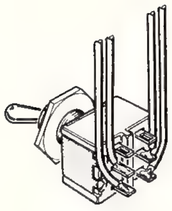
Miscellaneous:
X1* = 10 MHz crystal with 30 p series capacitance

* = see text

top of the case must be removed so that the surface here is completely flush.

The attractive finished appearance and correct operation of the meter can only be assured if the front panel foil available through Elektor's EPS service is used. It is an essential part of the circuit as it contains the membrane switches used to control the frequency counter. This foil is quite thick so the slots provided in the case to accomodate the metal panel supplied with the box will be too thin to accept both of these at the same time. For this reason a sheet of aluminium about 1 mm thick and with the same dimensions as the front plate supplied must be used instead. Use the template provided with the front panel foil to drill all the necessary holes in the new front plate.

The display board can be fixed to the plate by means of four countersunk bolts or with four bolts stuck to the inside of the panel. The locations for these holes or bolts are indicated by the template and it is important to note that the bolts may not protrude by more than 15 mm. The holes for the BNC sockets are drilled undersize and then filed to the right shape and size. One side of each hole is flat so the sockets cannot turn. The slot for the front panel cable must also be cut and then a final check made to make certain that everything fits as it should. The backing paper can now be taken off the front panel foil. Pass the cable through the slot and then stick the foil carefully and accurately onto the aluminium front plate. Any excess foil should now be cut off with a sharp knife. There is a thin layer of protective plastic on the front of the foil that can be removed when the case is completely finished.



84097-B

The wires to the mains switch can now be soldered in place. Note that they must rise straight up from the switch as otherwise they might foul the capacitors on the display board. (The sketch in the margin here indicates what we have in mind.) Insulate the connections very well, with short lengths of heat-shrink tubing, for example.

All the components must now be fixed to the front panel. A 10 k potentiometer must be fitted to the hole left in the display printed circuit board. The type used should ideally have small dimensions and an insulating washer must be used at the copper side of the board. This potentiometer will be used later — when the input stage is added to the meter.

Bend the display carefully towards the board and over IC6. Do this correctly and the display will fit exactly in the window in the front panel. Fix the display board to the front panel by means of the bolts already discussed.

The mains transformer is now fixed to the rear panel of the case so that its mounting bracket is about 2 mm below the top of the box. Fit the transformer above IC15, IC7 and IC17 in order to leave room for the input stage next month. Also fitted to the back panel is IC20 and in this case some heat-conducting paste must be used between IC and metal. The mains cable, naturally enough, feeds through the back panel, preferably by means of the chassis plug and socket arrangement normally used for laboratory test instruments.

Before screwing the top onto the case a heatsink must be fitted onto IC21.

The oscillator in the circuit can only be correctly calibrated with reference to another (accurate) frequency counter. Measure the frequency at pin 1 of IC18 and use the trimmer to set this to exactly 10 MHz. Fit the top onto the case and leave the meter on for about half an hour. Measure the frequency again and if necessary re-trim C3.

The constructional details of this frequency counter have been dealt with in much more detail than is usual in our circuits. We felt that this was necessary as it is a very important test instrument and the instructions given should enable any hobbyist to build a working example. Next month we will describe the input amplifier with the prescaler. All of the counter's functions are self-explanatory and selection is simplicity itself but it is always useful to familiarise yourself with any new equipment by experimenting with it. ◆

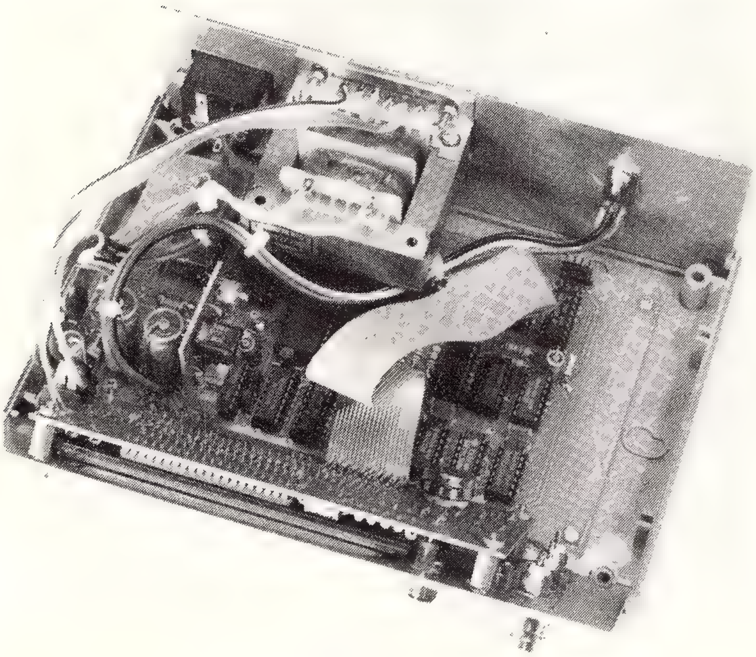
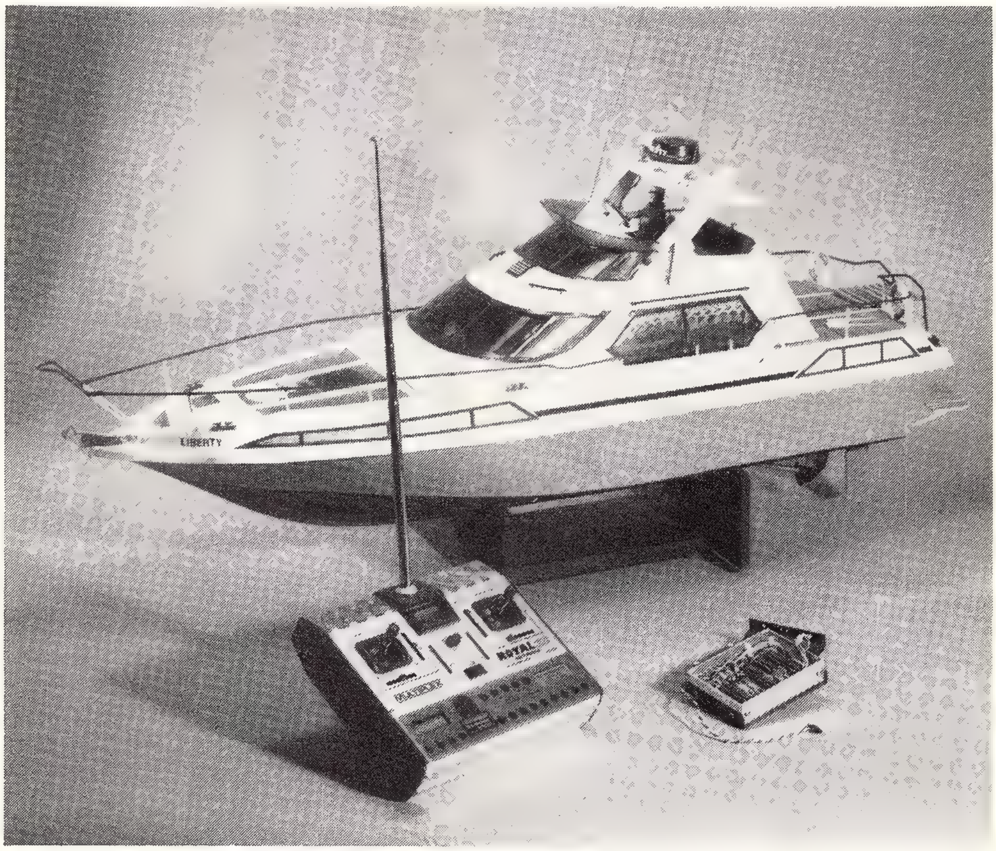


Table 2. This hexdump is the program that tests, drives and controls the frequency counter circuit.

```
      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
000: A9 E9 85 B4 85 B5 78 D8 A2 FF 9A 86 BA E8 8E 0D ......x.........
010: 20 8E 0F 20 CA 8E 0C 20 A9 6F 8D 0E 20 A9 0D 8D  .. ... .o.. ...
020: 0D 20 A9 14 8D 0F 20 A9 FC 2D 0E 20 8D 0E 20 A9 . .... ..-. .. .
030: FF 85 B7 20 35 E3 A9 C0 85 B7 20 35 E3 A9 AF 85 ... 5..... 5....
040: B7 20 35 E3 A9 80 20 92 E4 AD 0C 20 A9 0B 85 AA . 5... .... ....
050: A9 00 85 AB 20 87 EC A9 34 A2 02 85 A0 85 A2 85 .... ...4.......
060: A4 86 A1 86 A3 86 A5 A9 06 85 B9 58 A9 18 25 B4 ...........X..%.
070: 4A 8D 0E 20 A9 03 24 B4 F0 03 4C 89 E0 A9 04 24 J.. ..$...L....$
080: B4 F0 03 4C FF E0 4C 3D E1 A9 20 24 B4 D0 02 E6 ...L..L=.. $....
090: B9 A0 00 A9 01 24 B4 D0 02 A0 13 20 9E E4 20 6D .....$..... .. m
0A0: E5 20 FD E6 20 D4 E7 20 B1 EB 20 38 E6 20 51 E6 . .. .. .. 8. Q.
0B0: 20 FD E6 20 99 EC 20 2C EC A9 01 24 B4 D0 03 20  .. .. ....$...
0C0: 7F EB 20 F2 E9 A6 B9 B5 5A C9 05 B5 59 69 90 29  . .....Z...Yi.)
0D0: 0F 95 59 CA D0 F5 A5 5A D0 1B 24 59 38 A5 6A 70 ..Y....Z..$Y8.jp
0E0: 06 69 00 85 6A D0 0A E9 01 85 6A D0 04 A9 00 85 .i..j.....j.....
0F0: 59 A9 01 85 5A D8 20 5C EC 20 16 E7 4C 9E E0 A0 Y...Z. \. ..L...
100: 26 20 9E E4 20 0C E5 A9 40 25 B4 49 40 0A 09 08 & .. ...@%.I@...
110: 20 28 E5 A9 20 0D 0E 20 8D 0E 20 20 51 E6 20 FD  (.. .. ..  Q. .
120: E6 20 D4 E7 20 5C EC 20 16 E7 A9 DF 2D 0E 20 8D . .. \. ....-. .
130: 0E 20 A0 14 20 74 E4 88 D0 FA 4C 04 E1 A0 38 20 . .. t....L...8
140: 9E E4 20 0C E5 A9 40 25 B4 49 40 0A 09 03 20 47 .. ...@%.I@... G
150: E5 A9 20 0D 0E 20 8D 0E 20 20 5E E5 20 51 E6 A2 .. .. ..  ^. Q..
160: 09 A0 06 BD 4F 02 D0 20 BD 4F 02 D0 09 A9 20 99 ....O.. .O.... .
170: BC 00 C8 CA D0 F2 BD 4F 02 09 30 99 BC 00 C8 CA .......O..0.....
180: 10 F4 20 0C E5 4C 59 E1 A9 80 20 97 E4 A0 49 20 .. ..LY... ...I
190: 99 E1 A0 52 20 99 E1 F0 F4 20 9E E4 20 0C E5 A0 ...R .... .. ...
1A0: A0 20 74 E4 88 D0 FA 60 AE 0D 20 AD 0C 20 A9 1F . t....`.. .. ..
1B0: 2D 0E 20 8D 0E 20 A9 00 8D 0C 20 8A 10 13 A9 80 -. .. .... .....
1C0: 24 B4 F0 0A 20 97 E4 58 6E 00 A0 4C C8 E1 4C 06 $... ..Xn..L..L.
1D0: E0 A0 00 A5 B4 4A B0 09 C8 4A B0 05 C8 4A B0 01 .....J...J...J..
1E0: C8 20 FB E2 20 2D E4 30 F8 90 09 C8 C0 04 D0 F1 . .. -.0........
1F0: A0 00 F0 ED A9 01 C0 00 F0 0C 0A C0 01 F0 07 0A ................
200: C0 02 F0 02 A9 00 20 85 E4 A0 04 A9 18 25 B4 C9 ...... ......%..
210: 08 F0 14 C8 C9 10 F0 0F A9 03 24 B4 D0 08 A9 08 ..........$.....
220: 20 92 E4 4C 09 E2 C8 20 FB E2 20 2D E4 30 A2 90  ..L... .. -.0..
230: 15 C8 C0 06 D0 0A A9 03 24 B4 D0 04 A0 04 D0 E7 ........$.......
240: C0 07 F0 F8 D0 E1 A9 08 C0 04 F0 3F 0A C0 05 F0 ...........?....
250: 3A A9 10 2D 0E 20 F0 33 A9 01 25 B4 F0 2D A9 00 :..-. .3..%..-..
260: 20 1C E5 A0 0D A5 B5 D0 01 C8 20 FB E2 20 2D E4  ......... .. -.
270: 30 97 90 09 C8 C0 0F D0 F1 A0 0D D0 ED A9 00 C0 0...............
280: 0E F0 04 84 B5 D0 04 85 B5 A9 18 20 1C E5 A0 0D ........... ....
290: 84 B6 88 88 A9 07 24 B4 F0 17 84 B6 88 88 A9 04 ......$.........
2A0: 24 B4 D0 0D 84 B6 88 88 A9 20 24 B4 D0 07 C8 D0 $........ $.....
2B0: 04 A9 40 D0 F5 20 FB E2 20 2D E4 30 0B 90 1F C8 ..@.. .. -.0....
2C0: C4 B6 D0 F1 88 88 D0 ED A9 19 25 B4 49 01 F0 04 ..........%.I...
2D0: 49 18 D0 07 A9 10 2D 0E 20 D0 88 4C 09 E2 A9 03 I.....-. ..L....
2E0: 24 B4 F0 04 A9 20 D0 02 A9 40 C8 C8 C4 B6 F0 05 $.... ...@......
2F0: 20 97 E4 A9 00 20 92 E4 4C 06 E0 A9 64 85 B2 A9  .... ..L...d...
300: E3 85 B3 98 48 B9 55 E3 A8 A2 00 B1 B2 C9 30 D0 ....H.U.......0.
310: 02 A9 4F C9 2E F0 01 E8 C9 03 F0 08 85 B7 20 35 ..O........... 5
320: E3 C8 D0 E7 E0 11 F0 0A A9 20 85 B7 20 35 E3 E8 .......... .. 5..
330: D0 F2 68 A8 60 98 48 A0 08 AD 0E 20 6A 26 B7 2A ..h.`.H.... j&.*
340: 09 02 8D 0E 20 29 FD 8D 0E 20 88 D0 EC A0 08 88 .... )... ......
350: D0 FD 68 A8 60 00 0C 19 25 33 3D 47 51 63 75 80 ..h.`...%3=GQcu.
360: 8B 98 A5 B7 46 52 45 51 55 45 4E 43 59 20 3F 03 ....FREQUENCY ?.
370: 50 45 52 49 4F 44 54 49 4D 45 20 3F 03 50 55 4C PERIODTIME ?.PUL
380: 53 45 54 49 4D 45 20 3F 03 45 56 45 4E 54 20 43 SETIME ?.EVENT C
390: 4F 55 4E 54 20 3F 03 41 2D 49 4E 50 55 54 20 3F OUNT ?.A-INPUT ?
3A0: 03 42 2D 49 4E 50 55 54 20 3F 03 43 2D 49 4E 50 .B-INPUT ?.C-INP
3B0: 55 54 20 3F 03 36 20 44 49 47 2E 20 50 52 45 43 UT ?.6 DIG. PREC
3C0: 49 53 49 4F 4E 3F 03 37 20 44 49 47 2E 20 50 52 ISION?.7 DIG. PR
3D0: 45 43 49 53 49 4F 4E 3F 03 22 31 22 2D 54 49 4D ECISION?."1"-TIM
3E0: 45 20 3F 03 22 30 22 2D 54 49 4D 45 20 3F 03 50 E ?."0"-TIME ?.P
3F0: 4F 53 2E 20 53 4C 4F 50 45 20 3F 03 4E 45 47 2E OS. SLOPE ?.NEG.
400: 20 53 4C 4F 50 45 20 3F 03 46 52 45 51 2E 20 3C  SLOPE ?.FREQ. <
410: 20 31 30 30 20 4D 48 5A 20 3F 03 46 52 45 51 2E  100 MHZ ?.FREQ.
420: 20 3E 20 31 30 30 20 4D 48 5A 20 3F 03 AD 0E 20  > 100 MHZ ?...
430: 10 FB 20 74 E4 A9 1C 0D 0C 20 8D 0C 20 A9 04 4D .. t..... .. ..M
440: 0C 20 8D 0C 20 AD 0E 20 30 04 A9 80 D0 20 A9 0C . .. .. 0.... ..
450: 4D 0C 20 8D 0C 20 AD 0E 20 30 04 A9 40 D0 0F A9 M. .. .. 0..@...
460: 18 4D 0C 20 8D 0C 20 AD 0E 20 30 C1 A9 20 20 74 .M. .. .. 0..  t
470: E4 0A 0A 60 48 98 48 A2 19 A0 50 88 D0 FD CA D0 ...`H.H...P.....
480: F8 68 A8 68 60 48 A9 07 4C 8E E4 48 A9 18 20 97 .h.h`H..L..H.. .
490: E4 68 05 B4 85 B4 60 49 FF 25 B4 85 B4 60 A2 00 .h....`I.%...`..
4A0: B9 AC E4 95 BC E8 C8 C9 03 D0 F5 60 46 52 45 51 ...........`FREQ
4B0: 2E 20 30 2E 30 30 30 30 30 30 20 20 48 5A 03 50 . 0.000000  HZ.P
4C0: 45 52 2E 20 30 2E 30 30 30 30 30 30 20 20 53 45 ER. 0.000000  SE
4D0: 43 03 54 49 4D 45 20 30 2E 30 30 30 30 30 20 20 C.TIME 0.00000
4E0: 53 45 43 03 54 4F 54 41 4C 20 20 20 20 20 20 20 SEC.TOTAL
4F0: 20 20 20 30 03 4F 56 45 52 46 4C 4F 57 03 50 4C    0.OVERFLOW.PL
500: 45 41 53 45 20 52 45 53 45 54 2E 03 A9 BC 85 B2 EASE RESET......
510: A9 00 85 B3 A0 00 78 20 03 E3 58 60 20 8B E4 A9 ......x ..X` ...
520: 18 25 B4 4A 8D 0E 20 60 20 47 E5 20 5E E5 20 51 .%.J.. ` G. ^. Q
530: E6 20 FD E6 AD 1D 02 C9 30 F0 03 4C 88 E1 2C 0F . ......0..L....
540: 20 10 E8 20 5E E5 60 8D 0C 20 A9 3F 2D 0E 20 8D  .. ^.`.. .?-. .
550: 0E 20 6E 00 80 A9 40 0D 0E 20 8D 0E 20 60 6E 00 . n...@.. .. `n.
560: 60 A2 03 AD 00 40 9D 47 02 CA 10 F7 60 20 0C E5 `....@.G....` ..
570: A9 00 85 B8 85 BB A9 09 20 28 E5 E8 BD 47 02 D0 ........ (...G..
580: 15 E8 E0 03 D0 F6 BD 47 02 C9 10 B0 09 A9 04 85 .......G........
590: BB A9 12 20 28 E5 A0 00 A2 03 3E 47 02 CA 10 FA ... (.....>G....
5A0: C8 90 F5 84 B8 A2 03 3E 47 02 CA 10 FA C8 98 49 .......>G......I
5B0: 21 D0 F2 A0 F4 A9 20 24 B4 D0 02 A0 F7 18 98 65 !..... $.......e
5C0: B8 18 65 BB 30 0A F0 08 C9 02 B0 0A 69 01 D0 06 ..e.0.......i...
5D0: A9 00 85 B8 F0 3F 85 B8 0A 0A 09 02 20 47 E5 A0 .....?...... G..
5E0: 20 A9 20 24 B4 D0 02 A0 D0 20 74 E4 2C 0F 20 70  . $..... t... p
5F0: 06 88 D0 F5 4C 6D E5 20 5E E5 A9 20 24 B4 F0 09 ....Lm. ^.. $...
600: AD 48 02 C9 42 B0 ED 90 07 AD 47 02 C9 02 B0 E4 .H..B.....G.....
610: 2C 0F 20 10 E2 20 5E E5 20 51 E6 A9 18 25 B4 C9 .. .. ^. Q...%..
620: 18 D0 07 18 A5 B8 69 09 85 B8 A9 18 24 B4 D0 07 ......i.....$...
630: 18 A5 B8 69 04 85 B8 60 A9 00 A2 03 9D 47 02 CA ...i...`.....G..
640: 10 FA A4 B8 38 A2 03 3E 47 02 CA 10 FA 88 10 F5 ....8..>G.......
650: 60 A2 0F A9 00 9D 4B 02 CA 10 FA CE 5A 02 EE 5A `.....K.....Z..Z
660: 02 A9 09 CD 5A 02 F0 12 20 D2 E6 A2 03 38 BD 47 ....Z... ....8.G
670: 02 F9 D9 E6 C8 CA 10 F6 B0 E4 CE 5A 02 A2 03 BD ...........Z....
680: 47 02 9D 4B 02 CA 10 F7 20 D2 E6 A2 03 38 BD 4B G..K.... ....8.K
690: 02 F9 D9 E6 9D 4B 02 C8 CA 10 F3 90 05 EE 59 02 .....K........Y.
6A0: D0 E6 20 D2 E6 A2 03 18 BD 4B 02 79 D9 E6 9D 4B .. ......K.y...K
6B0: 02 C8 CA 10 F3 AD 59 02 AE 5A 02 E8 9D 4F 02 CE ......Y..Z...O..
6C0: 5A 02 10 07 AD 4E 02 8D 4F 02 60 A9 00 8D 59 02 Z....N..O.`...Y.
6D0: F0 B6 AD 5A 02 0A 0A A8 60 0A 00 00 00 64 00 00 ...Z....`....d..
6E0: 00 E8 03 00 00 10 27 00 00 A0 86 01 00 40 42 0F ......'......@B.
6F0: 00 80 96 98 00 00 E1 F5 05 00 CA 9A 3B A2 00 A0 ............;...
700: 09 B9 4F 02 09 30 9D 1D 02 E8 88 10 F4 8E 1C 02 ..O..0..........
710: A9 0D 9D 1D 02 60 A9 0F A6 AA E8 E8 3D 34 02 9D .....`......=4..
720: 34 02 2C 34 02 50 0D BD 33 02 C9 31 F0 0E 38 A9 4..4.P..3..1..8.
730: 00 FD 34 02 18 69 09 AA E0 13 90 03 4C 88 E1 86 ..4..i......L...
740: AF A0 FF A9 01 24 B4 F0 14 E0 07 D0 0C 20 FE E7 .....$....... ..
750: 20 FE E7 A2 00 A0 03 D0 0F E0 08 F0 F3 C8 E0 03  ...............
760: 90 06 CA CA CA 4C 5D E7 E8 A9 04 24 B4 F0 13 A9 .....L]....$....
770: 02 C5 AF D0 09 E6 AF A0 01 20 FE E7 A2 01 A5 AF ......... ......
780: 85 BA 20 8F EC A2 FF A9 01 24 B4 F0 03 E8 E6 AF .. ......$......
790: A0 00 E8 C8 B9 34 02 E4 AF D0 07 A9 2E 95 C1 E8 .....4..........
7A0: D0 F2 E4 BA 90 02 A9 20 95 C1 C4 B9 D0 E4 A9 20 ....... .......
7B0: 24 B4 F0 0B A9 04 24 B4 D0 05 E8 A9 20 95 C1 E8 $.....$..... ...
7C0: A9 20 95 C1 E8 A4 B0 B9 CD E7 95 C1 60 4E 55 4D . ..........`NUM
7D0: 20 4B 4D 47 20 99 EC 20 2C EC A2 03 8E 1C 02 A9  KMG .. ........
7E0: 31 8D 1D 02 A9 45 8D 1E 02 A9 37 8D 1F 02 A9 0D 1....E...7.....
7F0: 8D 20 02 20 99 EC 20 44 EC 20 F2 E9 D8 60 A2 08 . .. .. D. ...`..
```

```
      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
800: CA BD 35 02 E8 9D 35 02 CA D0 F5 A9 30 8D 35 02 ..5...5.....0.5.
810: 60 8D FF FF FF FF FF FF FF FF FF FF FF FF FF FF `...............
820: A5 47 49 80 85 47 A5 35 45 47 85 AC F8 20 94 EA .GI..G.5EG... ..
830: 20 68 EB F0 0D 20 74 EB F0 0B 24 AC 50 63 24 35  h... t...$.Pc$5
840: 50 03 20 7F EB F8 24 AC 70 03 4C B9 E8 A5 46 18 P.  ..$.p.L...F.
850: 65 58 B0 12 85 9D 20 9E EA C5 9A B0 09 20 F1 EA eX.... ...... ..
860: 20 C9 EA 20 DF EA A5 46 85 6A 20 FC EA 24 AC 30  .. ...F.j ..$.0
870: 58 20 27 EB A5 00 F0 17 20 85 EA A5 46 38 24 35 [ '..... ...F8$5
880: 50 15 E9 01 85 6A D0 07 A9 BF 25 35 4C 91 E8 A5 P....j....%5L...
890: 35 85 59 20 1C EB 60 69 00 85 6A 90 F2 20 8E EB 5.Y ..`i..j.. ..
8A0: 60 20 47 EB A5 9E F0 03 20 7F EB A5 46 C5 58 F0 ` G.....  ..F.X.
8B0: 05 90 F5 4C 3E E8 4C 45 E8 38 24 35 70 07 A5 46 ...L>.LE.8$5p..F
8C0: E5 58 4C 54 E8 A5 58 E5 46 4C 54 E8 20 38 EB A5 .XLT..X.FLT. 8..
8D0: 46 85 6A A5 35 85 59 20 5C EB F0 14 A5 01 D0 B3 F.j.5.Y \.......
8E0: 20 73 EA 24 59 38 A5 6A 50 0A 69 00 85 6A 90 EC  s.$Y8.jP.i..j..
8F0: 20 FB EB 60 E9 01 85 6A B0 E2 A9 01 85 6A A9 40  ..`...j.....j.@
900: 05 59 85 59 4C DC E8 F8 20 94 EA A9 00 85 9D 85 .Y.YL... .......
910: AD 20 68 EB F0 05 20 74 EB D0 08 20 FB EB 60 20 . h... t... ..`
920: 1C EB 60 20 F1 EA 20 07 EB 20 2A EA A5 47 45 35 ..` .. .. *..GE5
930: 85 AC 24 AC A5 46 70 1C 18 65 58 90 28 D0 55 A5 ..$..Fp..eX.(.U.
940: AD F0 14 24 35 70 59 A5 9E F0 51 A9 00 85 9E A9 ...$5pY...Q.....
950: 99 4C 65 E9 4C AB E9 24 35 50 41 A5 00 F0 F0 20 .Le.L..$5PA....
960: 85 EA 4C 4F E9 85 6A D0 53 A5 35 29 8F 85 59 A5 ..LO..j.S.5)..Y.
970: AC 30 31 A9 7F 25 59 85 59 A5 AD D0 44 A5 00 F0 .01. %Y.Y...D...
980: 10 20 85 EA A5 6A 24 59 70 5B 18 69 01 F0 09 85 . ...j$Yp[.i....
990: 6A 4C 1F E9 A5 35 85 59 24 59 70 04 20 8E EB 60 jL...5.Y$Yp. ..`
9A0: 20 FB EB 60 A9 80 05 59 4C 77 E9 38 E5 58 B0 B5  ..`...YLw.8.X..
9B0: 38 A5 58 E5 46 85 6A A5 47 4C 6D E9 A5 35 4C 6D 8.X.F.j.GLm..5Lm
9C0: E9 A5 9E F0 CC 24 59 A5 6A 38 50 09 69 00 F0 C8 .....$Y.j8P.i...
9D0: 85 6A 4C 1F E9 F0 05 E9 01 4C D0 E9 A5 59 09 40 .jL......L...Y.@
9E0: 85 59 4C C5 E9 38 E9 01 F0 05 85 6A 4C 1F E9 4C .YL..8.....jL..L
9F0: 65 E9 F8 20 74 EB F0 A4 20 68 EB F0 A3 20 94 EA e.. t... h... ..
A00: 20 FC EA 20 F1 EA 20 47 EB 20 4B EA A9 01 85 AD  .. .. G. K.....
A10: A5 47 49 40 85 47 20 12 EB A5 01 D0 03 20 73 EA .GI@.G ...... s.
A20: 20 2C E9 A5 47 49 40 85 47 60 A5 9A 85 9C C6 9C  ,..GI@.G`......
A30: A6 9C B5 24 85 9D C6 9D 30 06 20 27 EB 4C 36 EA ...$....0. '.L6.
A40: 20 85 EA C6 9C 10 E9 20 73 EA 60 A9 00 85 9C A9  ...... s.`.....
A50: 00 85 9D 20 38 EB 90 04 E6 9D D0 F7 20 27 EB 20 ... 8....... '.
A60: 73 EA A6 9C A5 9D 95 24 E6 9C A5 9C C5 9A F0 DF s......$........
A70: 90 DD 60 A2 00 B5 01 95 00 E8 E4 9A 90 F7 F0 F5 ..`.............
A80: A9 00 95 00 60 A6 9A CA B5 00 95 01 CA 10 F9 A9 ....`...........
A90: 00 85 00 60 A2 34 A9 00 95 00 CA 10 F8 60 F8 A2 ...`.4.......`..
AA0: 00 38 A5 9D E9 16 90 06 85 9D E8 4C A2 EA D8 A5 .8.........L....
AB0: 9D C9 0A 90 04 29 0F 69 09 86 9D 06 9D 06 9D 06 .....).i........
AC0: 9D 06 9D 05 9D 85 9D F8 60 A5 9D F0 23 A6 9A 85 ........`...#...
AD0: 12 95 13 CA 10 F9 A9 00 85 12 C6 9D D0 EB 60 A6 ..............`.
AE0: 9A B5 13 C9 05 B5 12 69 90 29 0F 95 12 CA 10 F5 .......i.)......
AF0: 60 A6 9A CA B5 48 95 13 CA 10 F9 60 A6 9A CA B5 `....H.....`....
B00: 36 95 01 CA 10 F9 60 A6 9A CA B5 36 95 24 CA 10 6.....`....6.$..
B10: F9 60 A6 9A B5 24 95 01 CA 10 F9 60 A6 9A CA B5 .`...$.....`....
B20: 01 95 5A CA 10 F9 60 A6 9A 18 B5 00 75 12 69 90 ..Z...`.....u.i.
B30: 29 0F 95 00 CA 10 F3 60 A6 9A 38 B5 00 F5 12 29 )......`..8....)
B40: 0F 95 00 CA 10 F5 60 A9 00 85 9E A6 9A CA 38 B5 ......`.......8.
B50: 36 F5 48 CA 10 F9 90 01 60 E6 9E 60 A6 9A E8 B5 6.H.....`..`....
B60: 00 D0 10 CA 10 F9 30 09 A6 9A B5 35 D0 05 CA 10 ......0....5....
B70: F9 A9 00 60 A6 9A B5 47 D0 F9 CA 10 F9 30 F2 A2 ...`...G.....0..
B80: 11 B5 35 B4 47 95 47 98 95 35 CA 10 F4 60 A6 9A ..5.G.G..5...`..
B90: CA A9 09 95 5A CA 10 FB A9 99 85 6A A9 00 85 59 ....Z......j...Y
BA0: A9 01 85 AE 60 A9 01 D0 0C A9 10 D0 08 A9 20 D0 ....`......... .
BB0: 04 A9 21 D0 00 48 A2 09 BD DD E8 95 8F CA 10 F8 ..!..H..........
BC0: 68 48 29 0F AA BD D8 EB 85 94 68 4A 4A 4A 4A AA hH).......hJJJJ.
BD0: BD D8 EB 85 92 4C 8F 00 35 47 59 6B 7D A2 11 B5 .....L..5GYk}...
BE0: 35 95 47 CA 10 F9 60 A2 11 A9 00 95 35 CA 10 FB 5.G...`.....5...
BF0: 60 A2 11 A9 00 95 47 CA 10 FB 60 A2 11 A9 00 95 `.....G...`.....
C00: 59 CA 10 FB 60 A0 00 B1 A6 85 59 C8 C4 9E F0 0A Y...`.....Y.....
C10: B1 A6 29 0F 99 59 00 4C 0B EC B1 A6 0A 0A 0A 0A ..)..Y.L........
C20: 85 6A C8 B1 A6 29 0F 05 6A 85 6A 60 A5 A0 85 A6 .j...)..j.j`....
C30: A5 A1 85 A7 A5 AA 85 9E E6 9E 20 FB EB 20 05 EC .......... .. ..
C40: 20 AD EB 60 A5 A2 85 A6 A5 A3 85 A7 A5 AA 85 9E  ..`............
C50: E6 9E 20 FB EB 20 05 EC 20 B1 EB 60 A0 00 A5 59 .. .. .. ..`...Y
C60: 91 A4 C8 C4 AA F0 02 B0 09 B9 59 00 09 30 91 A4 ..........Y..0..
C70: D0 F0 EA A5 6A 4A 4A 4A 4A 09 30 91 A4 C8 A5 6A ....jJJJJ.0....j
C80: 29 0F 09 30 91 A4 60 18 A5 AA 65 AB 85 9A 60 86 )..0..`...e...`.
C90: AF 84 B0 60 A6 AF A4 B0 60 A9 00 8D 34 02 A2 04 ...`....`...4...
CA0: 9D 17 02 CA 10 FA A6 AA E8 A9 30 9D 35 02 CA 10 ..........0.5...
CB0: FA E8 BD 1D 02 C9 2D D0 13 A9 80 0D 34 02 8D 34 ......-.....4..4
CC0: 02 A9 01 0D 17 02 8D 17 02 E8 D0 E6 C9 2B D0 02 .............+..
CD0: F0 EF BD 1D 02 C9 2E D0 0E 8E 19 02 A9 04 0D 17 ................
CE0: 02 8D 17 02 E8 D0 EB C9 45 D0 2B 8E 1A 02 A9 10 ........E.+.....
CF0: 0D 17 02 8D 17 02 E8 BD 1D 02 C9 2D D0 12 A9 40 ...........-...@
D00: 0D 34 02 8D 34 02 A9 02 0D 17 02 8D 17 02 D0 C2 .4..4...........
D10: C9 2B F0 F2 D0 BC C9 0D F0 02 D0 C8 A2 00 A9 01 .+..............
D20: 2D 17 02 F0 01 E8 BD 1D 02 C9 30 D0 0E EE 1B 02 -.........0.....
D30: A9 08 0D 17 02 8D 17 02 E8 D0 EB A0 00 AE 1B 02 ................
D40: A9 01 2D 17 02 F0 01 E8 BD 1D 02 C9 2E F0 F8 C9 ..-.............
D50: 45 F0 0F C9 0D F0 08 99 35 02 C4 AA C8 90 E8 4C E.......5......L
D60: 82 ED A9 02 2D 17 02 F0 01 E8 E8 A0 03 BD 1D 02 ....-...........
D70: C9 0D F0 0A E8 88 D0 F5 CA A9 0D 9D 1D 02 AE 1A ................
D80: 02 A9 02 2D 17 02 F0 01 E8 E8 C0 02 F0 19 BD 1D ...-............
D90: 02 0A 0A 0A 0A 8D 18 02 E8 BD 1D 02 29 0F 0D 18 ............)...
DA0: 02 8D 18 02 4C 5F ED 8D 1D 02 29 0F 8D 18 02 4C ....L_....)....L
DB0: 5F ED AD 17 02 29 FC D0 20 AC 1C 02 F0 14 A9 01 _....).. .......
DC0: 2D 17 02 F0 01 88 88 F0 09 30 0B 20 5F EE 88 D0 -........0. _...
DD0: FA 60 48 4C 37 EE 4C 17 EE C9 04 D0 06 AC 19 02 .`HL7.L.........
DE0: 4C BE ED C9 08 D0 0B AD 1C 02 38 ED 1B 02 A8 4C L.........8....L
DF0: BE ED C9 0C D0 06 AD 19 02 4C EA ED C9 10 D0 06 .........L......
E00: AC 1A 02 4C BE ED C9 14 D0 02 F0 D1 C9 18 D0 E6 ...L............
E10: AD 1A 02 D0 D5 F0 BB F8 98 48 AD 34 02 29 40 D0 .........H.4.)@.
E20: 48 38 AD 18 02 E9 01 8D 18 02 B0 0B 20 82 EE A9 H8.......... ...
E30: 40 4D 34 02 8D 34 02 D8 AD 18 02 D0 08 A9 BF 2D @M4..4.........-
E40: 34 02 8D 34 02 A6 AA AD 18 02 A8 4A 4A 4A 4A 09 4..4.......JJJJ.
E50: 30 9D 35 02 98 29 0F 09 30 9D 36 02 68 A8 60 F8 0.5..)..0.6.h.`.
E60: 98 48 AD 34 02 29 40 D0 0C 18 AD 18 02 69 01 8D .H.4.)@......i..
E70: 18 02 4C 37 EE 38 AD 18 02 E9 01 8D 18 02 B0 B7 ..L7.8..........
E80: 90 AA 38 A9 99 ED 18 02 18 69 01 8D 18 02 60 FF ..8......i....`.
E90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
EA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
EB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
EC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
ED0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
EE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
EF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
F00: D8 78 A2 FF 9A E8 8A A8 18 7D 00 EF 6E 00 A0 E8 .x.......}..n...
F10: D0 F6 AA D0 FD 88 D0 F0 A2 00 8E 0D 20 8E 0F 20 ............ ..
F20: CA 8E 0C 20 A2 6F 8E 0E 20 A2 04 8E 0D 20 8E 0F ... .o.. .... ..
F30: 20 8D 0C 20 8D 0E 20 38 2A 8D 0C 20 8D 0E 20 A2  .. .. 8*.. .. .
F40: 00 A0 00 EA EA EA EA EA 88 D0 F8 CA D0 F3 2C 0E ..............,.
F50: 20 30 E5 A9 00 8D 0E 20 A9 00 A2 00 85 00 86 01  0..... ........
F60: A9 00 A2 E0 85 02 86 03 A0 04 B1 02 91 00 C8 D0 ................
F70: F9 E6 01 E6 03 A2 08 E4 01 D0 EF A2 00 86 01 A2 ................
F80: E0 86 03 A0 04 B1 02 D1 00 D0 87 C8 D0 F7 E6 01 ................
F90: E6 03 A9 08 C5 01 D0 ED A9 20 8D 0E 20 A2 E0 86 ......... .. ...
FA0: 03 A9 00 A8 18 71 02 C8 D0 FA E6 03 A2 F0 E4 03 .....q..........
FB0: D0 F2 6E 00 A0 AA D0 FA 4C 00 E0 AD FF FF FF FF ..n.....L.......
FC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
FD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
FE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
FF0: FF FF FF FF FF FF FF FF FF FF 00 EF 00 E0 A8 E1 ................
```



G. Seegers

switching R/C channels

seven on/off switches for radio control, operated by a single (uni-directional) joystick

This is a time of year that could be considered 'quiet' for most radio control and modelling enthusiasts. That is not to say, of course, that they completely forget about their hobby just because there is a force 10 blowing outside. On the contrary, it provides a breather in which to repair damaged models, build new ones or to update and modify equipment. The circuit we will describe in this article falls into the last category. It consists of a relatively uncomplicated design that enables up to seven functions to be switched from the R/C transmitter using just one joystick.

The vast majority of radio control transmitters have at least one thing in common: they are fitted with joysticks. These joysticks enable the user to proportionally control various functions on his model, such as ailerons, rudder and throttle setting. The more sophisticated transmitters also provide a number of switching functions. This makes the model behave more realistically by allowing the user to switch lights on and off, raise and lower undercarriage and even drop bombs or fire torpedos. Desirable though these functions are, the transmitters that provide them are often out of the price range of many enthusiasts (including impoverished Elektor designers).

One common solution is to fit a microswitch inside the model and operate it by means of a servo. In this way one servo channel is needed to switch one function. Other methods involve making some changes to the actual transmitter. Neither of these methods particularly attracted us so we approached the problem from a completely different angle. In our final design the advantages are manifold: no changes have to be made to the transmitter, up to seven functions can be switched using a single proportional channel and operation is simple.

Moving a joystick switches the functions; forward for 'on', backward for 'off'. The joystick is moved the same number of times forward (or back) as the number of the function that is to be switched. Pushing the joystick four times forward turns on the function connected to 'channel' number four, and if the stick is moved three times backward the function controlled by 'channel' three switches off. A further advantage of this circuit over other types is that it 'remembers' the joystick's last movement so the relevant function remains on after the stick returns to the (neutral) mid-position.

One input pulse, seven output channels

Each proportional channel in a PWM (pulse width modulation) radio control receiver continually outputs pulses with a width of between 1 and 2 ms. The pulses appear 50 times per second and their width depends on the position of the appropriate joystick in the transmitter. This is illustrated in figure 1a; mid-position of the joystick corresponds to an output pulse of 1.5 ms at the receiver, one extreme (forward, for instance) gives a 2 ms pulse, the other extreme causes a pulse of 1 ms to be output. Lest there be any misunderstanding, let us clarify what is meant by a joystick pulse. We have referred to 'a pulse' but this is not strictly correct. In fact the 'pulse' in question is a pulse train in which all the pulses have the same width. For the purposes of this circuit the only joystick pulses that interest us are those that fall into two bands: 1.0...1.2 ms and 1.8...2.0 ms (as shown in figure 2a).

1a

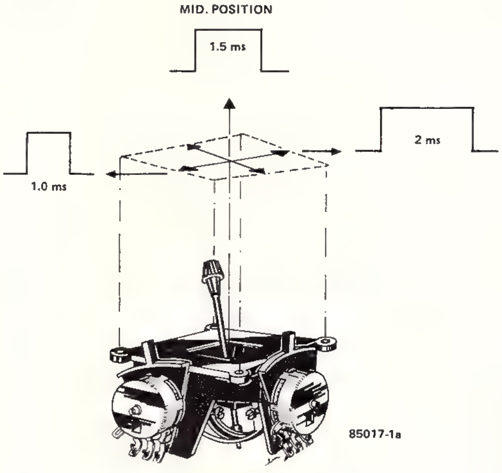


Figure 1a. When the joystick is moved from one end of its travel to the other the width of the corresponding output pulses in the R/C receiver go from 1 ms to 2 ms.

1b

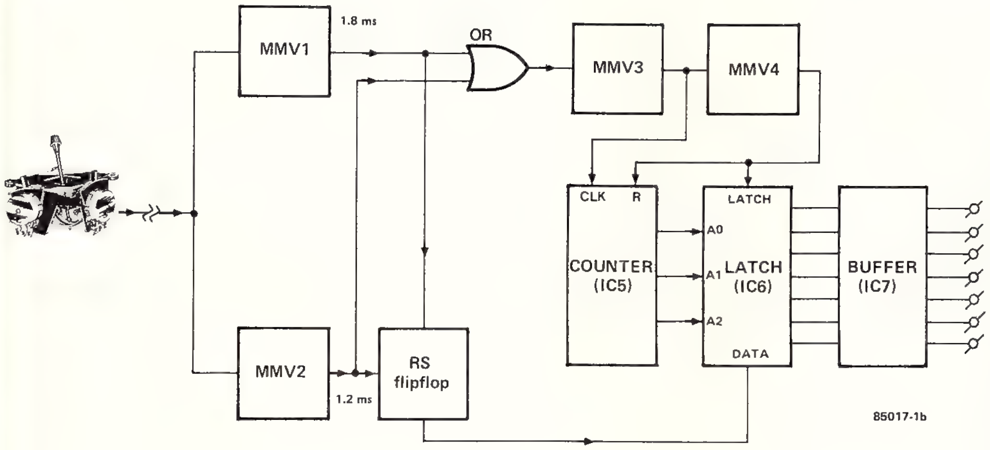


Figure 1b. The joystick pulses are input to the circuit whose main parts are seen here. There are two *pulse detectors*, MMV1 and MMV2, that determine the data stored in a flip-flop. The *counter* is incremented every time the joystick is moved to one end and the final number stored determines into which of the *latches* in IC6 the information from the flip-flop is loaded. The outputs are driven from the *latch* via the *buffer*.

The block diagram of figure 1 and timing chart shown in figure 2 give an insight into the operation of the circuit. The joystick pulses that are output from the R/C receiver must first be detected. Pulses greater than 1.8 ms are detected by MMV1, those smaller than 1.2 ms by MMV2. Depending on which of these conditions is met the R/S flip-flop is set or reset. In either case MMV3 will be activated and its output pulse will subsequently clock the counter and trigger MMV4.

The counter counts the number of output pulses given by MMV3, which is the same as the number of joystick pulses. Each pulse input to MMV4 retriggers it so its outputs remain active until about 2.5 seconds after the last MMV3 pulse. (This time can be made longer or shorter at will by changing the value of R6.) The effect of this is that about 2½ seconds after the last joystick movement the eight-way latch (IC6) is enabled by MMV4. When this happens the information fed into the data input from the flip-flop is placed in the latch selected. Which latch is selected depends on the counter output and this, as we have seen, is determined by the number of joystick pulses input to the circuit. The information in the latch is then fed via the buffer to the output so one of the seven lines is switched on or off. The counter is now reset by MMV4.

From joystick to switches

The complete circuit diagram is shown in figure 3. The R/C transmitter need not be changed at all to allow this switching function to operate but the circuit does monopolise the channel for one joystick, which means that one less servo is available. When the joystick is moved from one extremity to the other (from fully backwards to fully forward, for example) the pulses output from this channel in the receiver vary from 1...2 ms.

If the pulses are less than 1.2 ms wide MMV2 detects this and makes the output of flip-flop N5/N6 high. Ultimately this will mean that a '1' will be fed into latch IC6. If, on the other hand, the pulses are greater than 1.8 ms the $\overline{Q1}$ output of MMV1 makes pin 4 of N6 go low so a '0' will be fed into IC6. Any noise that might be present in the signals is removed by R3/C3 and R4/C4 as otherwise it could corrupt the data in the flip-flop and trigger

2a

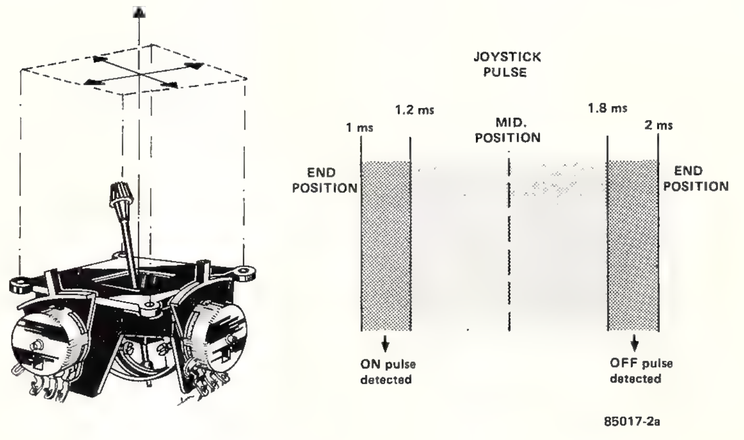


Figure 2a. The joystick pulses that interest us for this circuit are located in two bands: 1.0...1.2 ms and 1.8...2.0 ms. One of these bands is used to switch functions on, the other to switch them off.

2b

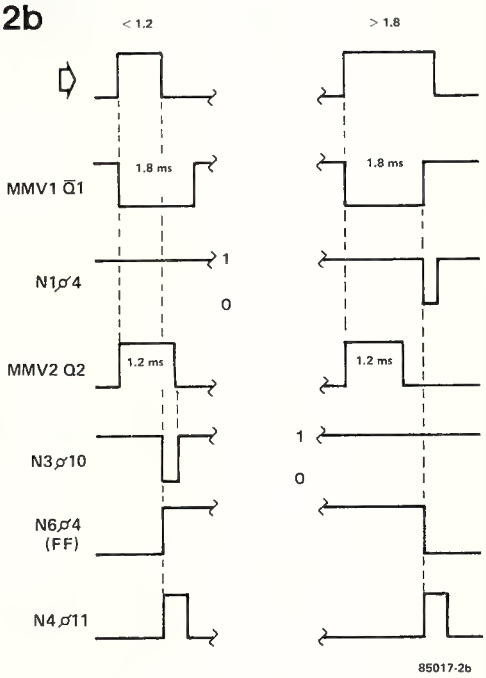


Figure 2b. When the joystick pulses are input to the circuit the signals at various points are, of course, effected. Here we see how the most important signals react to the two conditions that interest us.

MMV3.

Whether the joystick pulse is long or short it must still be added to the contents of IC5 as it is the number of times that the joystick is pushed to one extremity that determines the count stored in the 4029. When the output of N4 goes low it triggers MMV3. The rising edge of this monostable's output pulse clocks IC5 (once for every time the joystick is moved) and triggers MMV4. When the channel to be selected is reached the joystick is no longer moved so MMV4 is not retriggered after this. About 2.5 seconds later its monostable time elapses and its Q2 output takes the enable input of latch IC6 low. This is a very unusual latch. When pin 4 is taken low the data presented to pin 3 (Data) is input to whichever of the eight internal latches is selected via the address inputs, A0...A2. The lowest latch will never be selected because this is taken as the base level, to which the IC returns on reset. (Incidentally, all the flip-flops in the latch are reset on power-up by means of C8 and R9.) Outputs Q1...Q7 of the 4099 are linked directly to the inputs of buffer IC7. The outputs of the ULN2003 darlington array are used to drive the various switching functions.

At the same time as MMV4 latches IC6 its $\overline{\text{Q2}}$ output returns high and resets counter IC5 (after a slight delay incurred via N7 and N8).

The outputs

Every one of the outputs, pins 10...16 of IC7, can be used to switch one function on and off. All the outputs are the same and the layout used is shown in the 'blow-up' in figure 3. Each consists of a darlington that can handle a maximum current of 500 mA and a maximum voltage of 30 V.

If the outputs drive inductive loads, such as relays, the internal diodes in the buffer must be used in order to suppress the inductive transients. This simply involves connecting pin 9 to the positive voltage supply line.

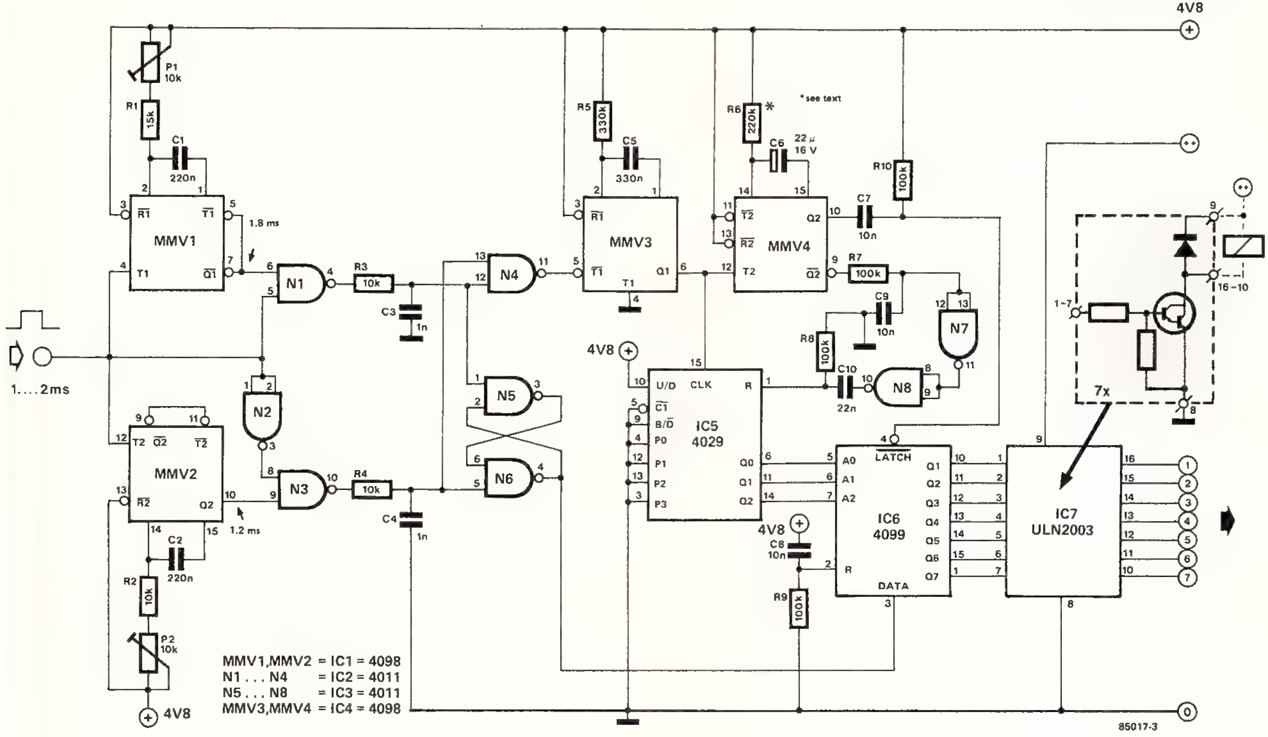
Construction and calibration

There is little involved in constructing this circuit. All the components fit quite easily on a smallish piece of Veroboard. The input can then be linked to the radio control receiver in place of one of the servos. After calibration the outputs are connected to the functions that they will switch.

Before the circuit can be calibrated preset P1 must be set to maximum resistance, preset P2 to minimum resistance and a multimeter (10 V d.c. range) must be connected between pin 6 of IC4 and ground. The R/C transmitter is then switched on, followed by the receiver. The output of pin 6 is low so the meter indicates zero volts.

- Move the joystick to half-way between centre position and fully forward. Turn P2 until the meter deflects. This indicates that the output of pin 6 has gone high.
- Release the joystick and it returns to mid-position. The meter should again indicate zero volts.

3



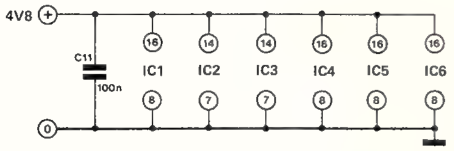


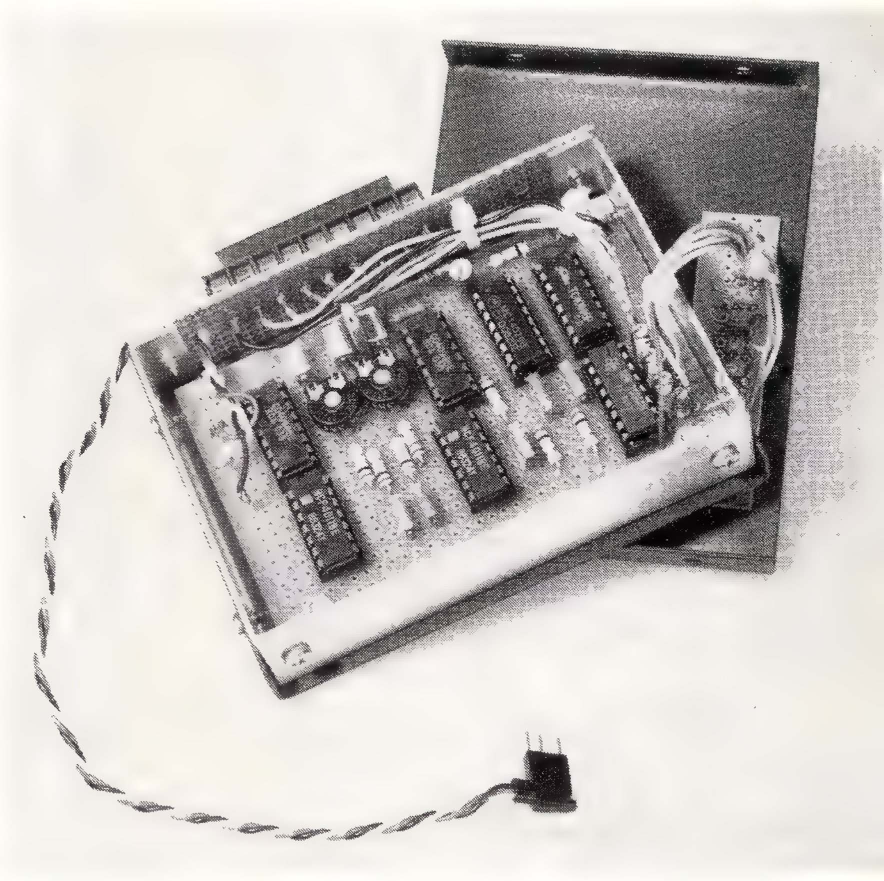
Figure 3. The photographs at the start of this article and below shows the prototype of this circuit, the diagram of which is shown here. Clearly it is small enough to be easily constructed on a piece of Veroboard. The current consumption in the circuit is neglegible because CMOS ICs have been used throughout.

- Move the joystick to half-way between centre and fully backward. Turn P1 until the meter again deflects to indicate that pin 6 has gone high.
- When the joystick is released it returns to mid-position and the meter indicates zero volts. The calibration is now complete.

Switching with the joystick

In use this circuit will soon show its worth. Admittedly the method used is not the quickest imaginable way of switching functions using R/C equipment but it is fast enough for many non-critical applications. The most important functions in a boat or plane or whatever need to be proportional in any case so they could not simply be switched on and off with this, or any other, circuit.

Whatever the functions are used for it is very important to remember what is controlled by each 'channel'. It could come as somewhat of a surprise if you move the joystick forward three times expecting to switch on the lights in your boat, for example, only to find the anchor suddenly lowering itself. Apart from that using the circuit is very simple. Move the joystick X times towards you to switch channel X on, or Y times away from you to turn channel Y off. That is all there is to it!



applicator

Output amplifier IC Type LM 1875

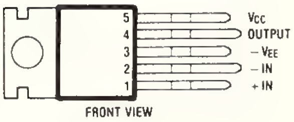
The LM 1875 from National Semiconductor is a monolithic output amplifier that can provide up to 20 watts audio power of excellent quality. It is housed in a TO-220 encapsulation in which you would normally expect no more than a small voltage regulator.
Maximum output power is 35 watts into 8 ohms, but the distortion at this level is no longer acceptable for hi-fi purposes. At 20 W, however, the harmonic distortion is only 0.05% at 1 kHz. The bandwidth is a very reasonable 70 kHz, while the slew rate of 8 V/μs is excellent for this type of IC. Other plus points are the very good hum suppression of 94 dB, the thermal protection circuit, and the short-circuit protection. Further characteristics are given in Table 1.
The LM 1875 has five connecting pins: two for the supply voltages (positive and negative), one for the output, and two for the inputs (inverting and non-inverting).
Two possible circuits are given in figure 1: one with a symmetrical supply (a) and the other for use with an asymmetrical power supply (b). Figure 1a is noteworthy for the minimal number of additional components required: two diodes, D1 and D2, for the protection of the output transistors, high-pass filter C5/R5, input filter C1/R1, negative-feedback network R2/R3/R4/C2, and decoupling capacitors C3 and C4.
The gain, A, is determined by A = 1+R4/R3.
The characteristics in figure 2 show the total harmonic distortion, THD, versus power output and frequency and the power output versus the supply voltage.
Because of its small dimensions, the quality of the output, and the small number of external components required, this IC is eminently suitable for use in active loudspeaker systems.

Table 1

Absolute Maximum Ratings

Supply Voltage	± 30 V
Input Voltage	$-V_{EE}$ to V_{CC}
Operating Temperature	0°C to +70°C
Storage Temperature	−65°C to +150°C
Junction Temperature	150°C
Power Dissipation (Note)	30 W
Lead Temperature (Soldering, 10 seconds)	300°C

TO-220 Power Package (T)



Electrical Characteristics

V_{CC} = 30 V, $-V_{EE}$ = −30 V, T_{TAB} = 25°C, R_L = 8 Ω, A_V = 32 (30 dB), f_o = 1 kHz, unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Units
Supply Current	P_{OUT} = 0 W		60	100	mA
DC Output Level			0		V
Output Power	THD = 1%		30		W
THD	P_{OUT} = 20 W		0.05		%
	P_{OUT} = 20 W, f_o = 20 kHz		0.2	0.4	%
	P_{OUT} = 30 W		0.1		%
	P_{OUT} = 30 W, f_o = 20 kHz		0.4	1.0	%
	P_{OUT} = 20 W, R_L = 4 Ω		0.06		%
	P_{OUT} = 20 W, R_L = 4 Ω, f_o = 20kHz		0.3	0.6	%
Offset Voltage		−30	± 5	30	mV
Input Bias Current		−5	−2	5	μA
Input Offset Current		−1.5	0	1.5	μA
Input Sensitivity	P_{OUT} = 20 W, f_o = 20 kHz		400	450	mVrms
Open Loop Gain			90		dB
PSRR	V_{CC}, 120 Hz, 1 Vrms	52	93		dB
	$-V_{EE}$, 120 Hz, 1 Vrms	52	95		dB
Max Slew Rate			8		V/μs
Current Limit		3	4		A
Equivalent Input Noise Voltage	R_s = 600 Ω, CCIR		3		μVrms

Note: Assumes T_{TAB} to 60°C max. For operation at higher tab temperatures and at ambient temperatures greater than 25°C, the LM 1875 must be derated based on a maximum 150°C junction temperature. Thermal resistance depends upon device mounting techniques.

Table 1. **Absolute maximum ratings and electrical characteristics.**

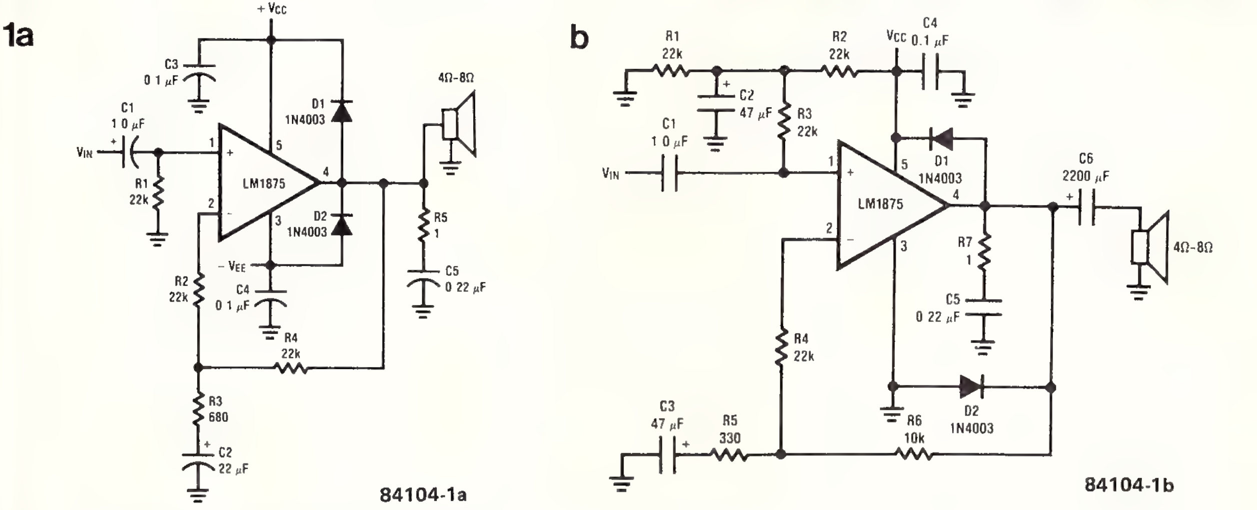


Figure 1. Two possible circuits for an output amplifier based on the LM 1875: one for use with a symmetrical power supply (a) and the other for an asymmetrical supply (b).

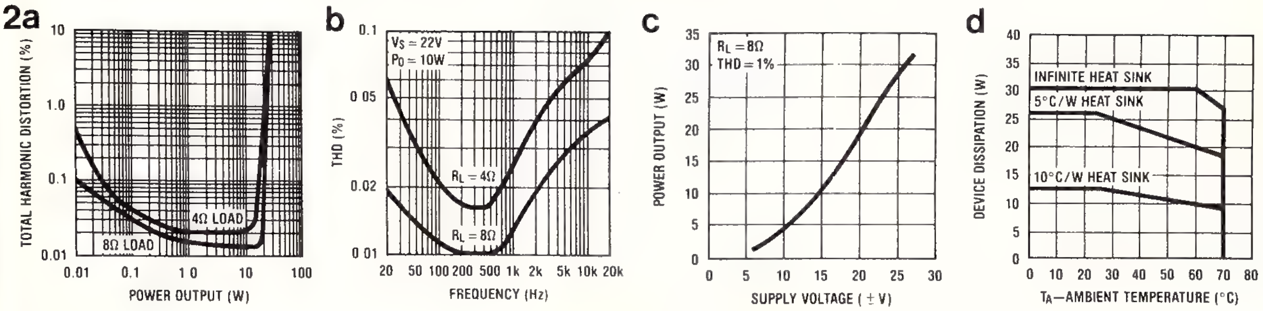


Figure 2. Total harmonic distortion versus power output (a); total harmonic distortion versus frequency (b); power output versus supply voltage (c); internal dissipation versus ambient temperature (d).

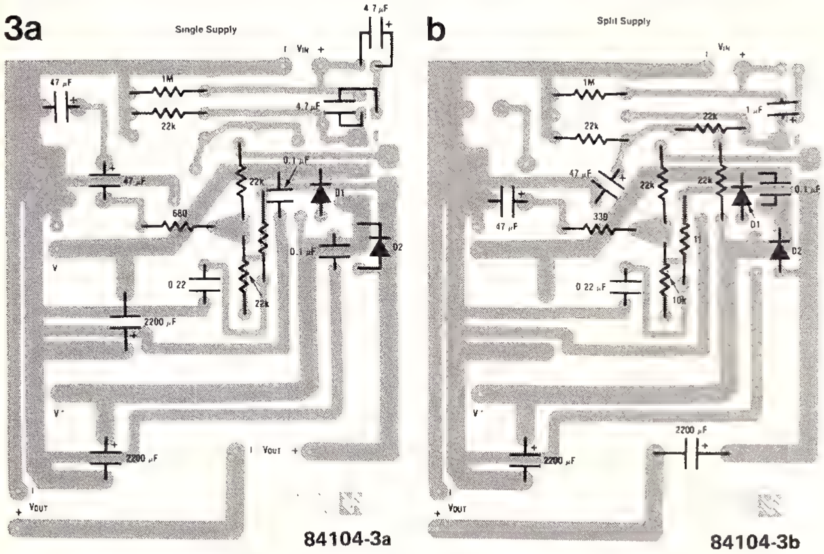


Figure 3. Printed-circuit layout of the two suggested circuits of figure 1: (a) with symmetrical and (b) with asymmetrical power supply.

Literature:

National Semiconductor:
Preliminary Application
Note on the LM 1875

National Semiconductor addresses:
United Kingdom:
301 Harpur Centre
Home Lane
Bedford
Phone: (0234) 47147

Denmark:
Bianco Lunos Alle 1
1868 Copenhagen V
Phone: (01) 213211

Southern Europe:
Via Solferino 19
20121 Milano
Italia
Phone: (02) 6596146

Spain/Portugal:
c. Agustin de Foxa 27 (9 d.)
E-Madrid 16
España
Phone: (01) 7332954

Northern Europe:
Postadress Box 2016
S-127 02 Skärholmen
Sverige
Phone: 08-970190

Outside Europe:
2900 Semiconductor Drive
Santa Clara
California 95051
USA
Phone: (408) 721-5000

market

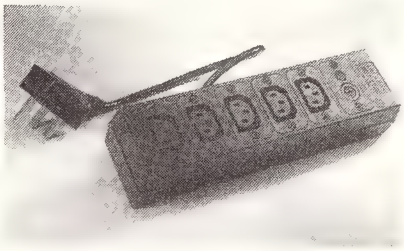
Power reed relay

New from Hamlin Electronics Europe Ltd is a high-power reed relay with a one-make contact. Designed for screw mounting, the device has 0.25 inch male quick connects for coil and switch terminals. It is housed in a flame-retardent plastic encapsulation to UL-90-VO. Maximum switching capability is 15 A at 250 V a.c. or 30 A at 110 V a.c. Maximum switching voltage is 600 V a.c. With a required coil power of 0.5 W, the relay is ideal for switching lamps, motors, heating elements, electromagnetic contactors, and valves for industrial and domestic equipment.

Hamlin Electronics Europe Ltd
Diss
Norfolk IP22 3AY
(0379) 4411 (3017 M)

New versions of Stripbloc

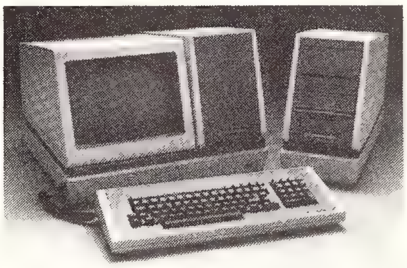
New versions of the Stripbloc CEE 22 a.c. outlet are now available from Rendar Limited. Moulded in rugged black ABS plastic, this multi-power-outlet uses BEAB accepted components and meets the requirements of BS 5733 and the European CEE 22 standards. Ideal for rack mounting, the panel-mounted Stripbloc is capable of providing up to six connections from one power source. Optional features include a neon indicator and fuse, which take up one of the socket positions, and, on the free-standing variants, a standard CEE22 inlet, and a filtered inlet. This last version is particularly suited to sensitive equipment.



Rendar WKR Limited
Durban Road Industrial Estate
Bognor Regis
West Sussex PO22 9RL
(0243) 825811 (3020 M)

ZEN assembly code system

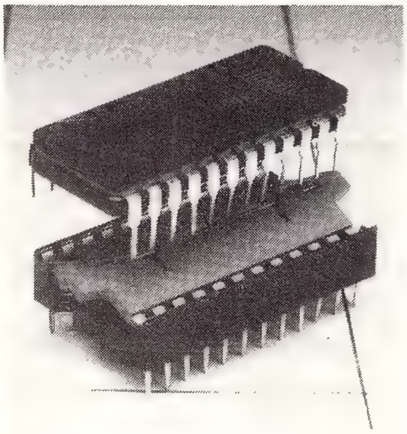
Kuma Computers have confirmed their standing as the leading software house for MSX products in Europe by commencing deliveries of their ZEN Assembly Code System to software houses on time as promised. ZEN is a complete Z80 assembler, editor, debugger, and disassembler, enabling machine code programs to be developed on MSX micros. It ensures that there will be a wide range of software available for the MSX machines when they are launched. ZEN will retail at £19.95.



Kuma Computers Limited
12 Horseshoe Park
Horseshoe Road
Pangbourne
Berkshire RG8 7JW
(07 357) 4335 (3025 M)

ZIF sockets

No force is required to insert or remove ICs from the new range of IC sockets from Dage. The sockets have a hinged base with fingers that protrude by approximately 1.5 mm at either end. After the IC is inserted, a little pressure on the fingers will cause the hinge to click over and lock the legs of the IC in place. Four versions are available, for ICs with 24, 28, 40 and 48 pins. All are low-profile style with a height of 5 mm. The contacts are made of copperberyllium with either tin-lead or selective gold plating.



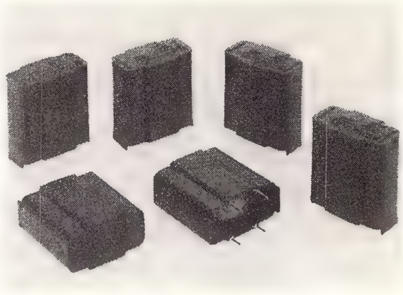
The sockets are stackable, side-to-side, for high density printed circuit board layouts. A lead-in entry point ensures easy IC insertion, with the point of contact located 0.8 mm from the top of the socket.

Dage Eurosem
Rabans Lane
Aylesbury
Bucks HP19 3 RG
Telephone:(0296) 33200 (3045 M)

New mains suppression chokes

Iskra has introduced a new range of PCB mounted mains interference suppression chokes, the EDT series.

Originally developed for applications in consumer equipment, the new filters are designed to suppress incoming and equipment generated low frequency and medium frequency conducted RFI. A typical application would be the protection of microprocessing equipment controlling electrical pumps, fans or motors and all other units having a potential for producing mains interference. The choke consists of two inductors symmetrically wound on a common ferrite ring core. Inductance values of each arm of the two windings (which are electrically isolated from one another) range from 12 mH to 27 mH but other values can be supplied to special order. Typical resistance values per winding are: 0.6 ohms for the 12 mH version increasing to 0.7 ohms for the 27 mH version. Current rating is 1 A at rated voltage of 250 V AC and the filters will withstand 2000 V a.c. 50 Hz test voltage (applied between windings). This device can be an efficient custom built transient filter when used in conjunction with the Iskra KNB series 'X' and 'Y' capacitors.



Overall dimension are 33.5 m × 36.5 × 18 m and the housing is made of a self extinguishing plastic material to UL94V0.

Iskra Ltd.,
Redlands,
Coulsion,
Surrey CR3 2HT.
Telephone: 01 668 7141. (3088 M)

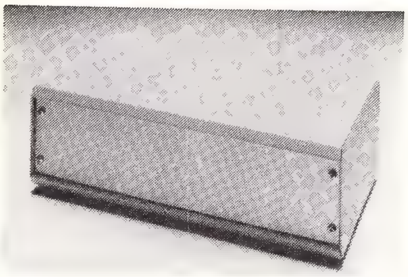
Video head replacement and maintenance kit

The average video head needs replacing every two or three years and can cost over £100 in repair charges. The Monolith Electronics Company Limited, specialist manufacturer and supplier of magnetic tape heads and systems, has now introduced their VMC-02 video head replacement and maintenance kit which contains everything the home enthusiast needs to reduce this expense substantially. Included in the kit are a novel head-concentricity gauge for the alignment of Betamax heads to an accuracy better than three thousandths of a millimetre, a stroboscopic tacho disc which verifies the head rotational speed on VHS machines, a pair of handling gloves, a cross-head screwdriver, an inspection mirror, a can of air-blast dust remover, an anti-static cloth, cleaning fluid, shaped spatulas, replacement service labels, and a quality mains-operated soldering iron with solder. A set of step-by-step instructions and a stock list of heads available from Monolith are provided and all customers can make free use, by telephone, of Monolith's advisory and service department. The total cost of the kit, including VAT, is £19.95 plus £1.50 p&p by mail order. The kit may be used repeatedly for routine maintenance and head replacements.

The Monolith Electronics Company Ltd
5-7 Church Street
Crewkerne
Somerset TA18 7HR
(0460) 74321 (3014 M)

'Impak' small instrument case

Imhof has introduced a re-styled version of its popular Impak packed-flat small instrument case featuring casing panels with attractive bevelled edges, and an easy assembly system. Designed specifically to provide a good-looking stand alone enclosure for small desk-top instruments, the new design has superceded the established range. Assembling the case is a quick and simple operation, using plastic bushes in threaded inserts which effectively rivet the parts together when the screws are tightened. The construction system gives the case good strength and rigidity.



Available with an oatmeal finish on the body, and bitter chocolate rear panel, Impak small instrument cases range in size from overall height of 76 mm, width of 204 mm, and depth of 152 mm, up to 159 × 432 × 197 mm. Standard sizes are available through the company's Express Catalogue service, and other sizes can be manufactured to order.

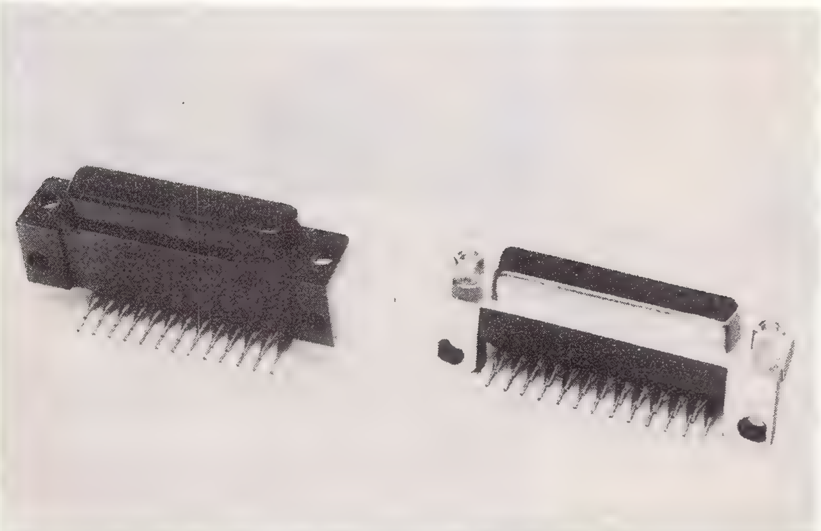
Imhof-Bedco Standard Products Limited,
Ashley Works,
Ashley Road,
Uxbridge,
Middlesex.
Telephone: 0895 37123 (3089 M)

Subminiature D-connectors for PCB mounting

Subminiature D-connectors from the 420 Series offer five choices of contact number from 9 to 37-ways, with rightangled receptacle for PCB-mounting.

The 420 connectors feature all-plastic construction and offer a standard footprint on the receptacle half for PCB mounting. The connector is moulded from UL94V-0 insulator, and inserted with contacts having gold-plated copper-alloy contacts in the connector body, and tin-lead plated tails. A large cavity facilitates insertion of the male connector. The 423 connectors provide a metal shell over its UL94V-0 insulator body. Contacts are copper-alloy with selective gold plating. The receptacle component features a short footprint for increased circuit density.

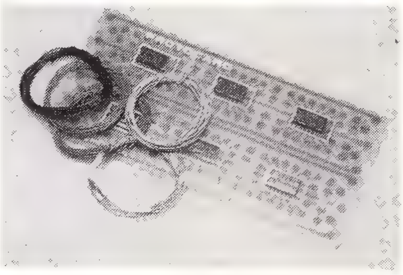
Dage (GB) Ltd,
Eurosem Division,
Rabans Lane,
Aylesbury,
Bucks HP19 3RG.
Telephone: 0296 33200. (3084 M)



New prototyping board

PROTOCARD is a new board for easy construction of prototypes. Six 16-pin DIL sockets have their pins brought out to large solder pads allowing components to be easily tacked onto the board. Each IC is marked with a pin location and supply tracks, signal tracks, etc. run the full length of the board.

PROTOCARD can be used as many times as required by simply removing all components from the board.



Each PROTOCARD is supplied with a pack of planning cards which enable the component layout to be planned, as well as with solder and instrument wire.

PROTOCARD measures 210 × 100 mm and is priced at £8.50 post paid (UK only).

E & H electronics
33 North Street
Keighly
West Yorkshire
BD20 3SL
Phone: (0535) 44103 (3071 M)

Electronic glue gun

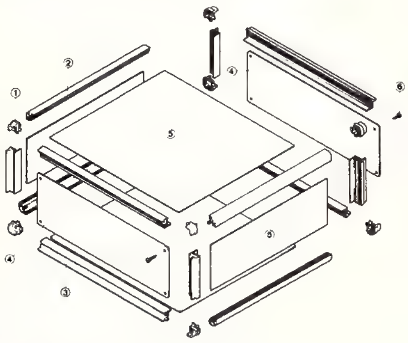
Thermoplastic adhesives are finding ever increasing uses within industry as well as the hobbyist's workroom. They can be used on PVC, Plexiglas, Perspex, minirals, asbestos, cement, paper, glass, brass, aluminium, steel, concrete, softwood, and hardwood. An accurate chart of bonding strength is available on application. Supply voltage is 100 to 250 V, heating-up time is 7...10 min, and melting temperature is controlled electronically at 260°C. The Glue Matic 3000 for constant use is fitted with a trigger to feed in the 200 mm long sticks of glue. Electronic glue guns, together with over 3000 other tools and production aids, can be found in the Toolrange 1983/84 catalogue.

Toolrange Limited
Upton Road
Reading
Berkshire RG3 4JA
(0734) 22245 (3010 M)

Precision d.i.y. enclosure system

Anyone requiring small rumbers of enclosures to their precise specification, can now produce them 'in-house' using the new Varidesign system from Frepar. Manufactured in West Germany, the d.i.y. kit comprises three components — two alumium extrusions, plus corner piecès. Together with the front sections, the side sections form the frame of the case. The corner pieces are manufactured in black, glass-fibre reinforced maclaron, and the extrusions in E6/EV1 are supplied in one metre lengths. Infill panels are supplied by the customer who is therefore not restricted in his choice of material. Material up to 2,5 mm thick is accepted by the extrusions.

The system is put together rather like a cubic picture frame, the panels being slid into place before the corner pieces are pressed in. End panels are srewed in, the extrusion having a built-in duct to accept self-tapping screws. The front extrusion has, as part of its profile, facility to hold a p.c.b. or mounting-plate.



(1) Corner piece
(2) Side section
(3) Front section
(4) Front and rear panels
(5) Top, base and sides
(6) Fixing screws

This Varidesign system complements the existing Frepar range which includee 12, 16, 19 and 25 way plug-in enclosures. A new quick release DIN rail-mounting connector is now available for this range.

Frepar Electronics Limited,
119 Newland Street,
Witham,
Essex CM8 1BE. (3087 M)

PRINTERS

DOT MATRIX

All printers have centronic parallel interface unless otherwise stated. All printers have hi-res dot addressable graphic mode. Please send SAE for full details.

EPSON

FX80 160CPS 10″ wide friction & pin feed	£347 + VAT	**£399**
FX100 160 CPS 15″ wide friction & tractor feed	£499 + VAT	**£574**
RX80 F/T 100 CPS 10″ wide friction & tractor feed	£239 + VAT	**£275**
RX80 100 CPS 10″ wide tractor feed	£199 + VAT	**£229**
RX100 F/T 100 CPS friction & tractor feed	£385 + VAT	**£443**
8143 RS 23 Interface for FX and RX printers	£39 + VAT	**£45**
8148 RS 232 Interface with 2K buffer x on x off	£60 + VAT	**£69**
Ribbon Cartridge for RX80 FX80 & MX80	£5 + VAT	**£6**
Ribbon Cartridge for FX100 & MX100	£7 + VAT	**£8**

STAR

Gemini 10X120 CPS 10″ wide friction & tractor feed	£200 + VAT	**£229**
Gemini 15X120 CPS 15″ wide friction & tractor feed	£295 + VAT	**£339**
Gemini Ribbon	£3 + VAT	**£3**

SEIKOSHA

BP 420 designed for the business world, 420CPS in draft mode, 110CPS in NLQ mode. £1095 + VAT **£1259**

SMITH CORONA

Fastext 80: 80 col, 80CPS. Friction feed standard
£149 + VAT **£171**

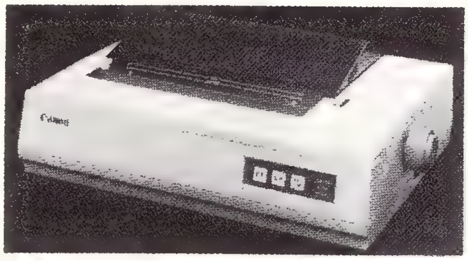
TAXAN KAGA

160CPS 10″ wide 27CPS NLQ 24 × 16 matrix	£269 + VAT	**£310**
160CPS 15″ wide 27CPS NLQ 24 × 16 matrix	£349 + VAT	**£401**

CANON

PW1080A
160CPS NLQ mode, 27CPS, 10″ wide friction & tractor feed
£299 + VAT **£344**

PW1156A
160CPS NLQ mode, 15″ wide friction & tractor feed
£379 + VAT **£436**



COLOUR PRINTERS

Seikosha GP700A 7 colour 50CPS printer	£299 + VAT	**£344**
Canon PJ1080A 7 colour 40CPS ink jot printer	£391 + VAT	**£449**

DAISYWHEEL

JUKI 6100/I PRINT

20 CPS Bi-Directional Logic seeking 10 12 15 CP1 + PS spacing 2K buffer best selling Daisywheel	£324 + VAT	**£373**
Singer sheet feeder unit	£182 + VAT	**£209**
Tractor Unit	£95 + VAT	**£109**
RS 232 Interface	£52 + VAT	**£59**
Spare Daisywheel	£14 + VAT	**£16**

BROTHER HR-15

13 CPS Bi-directional 10, 12, 15 CP1 + PS	£344 + VAT	**£395**
Keyboard Unit	£139 + VAT	**£159**
Single Sheet Feeder Unit	£217 + VAT	**£249**
Tractor Unit	£95 + VAT	**£109**

QUENDATA

20 CPS Unidirectional 10 12 15 CP1	£217 + VAT	**£250**

All our printers have 1 year warranty

MONITORS

PHILIPS

7001 High Res Green Screen with sond input £65 + VAT **£75**

GM1211

GM1211 18 MHZ High Res Monochrome Monitor with tilt and swivel stand available in green or amber etched antiglare screen (please specify colour £86 + VAT **£99**

SANYO

DM8112 12″ Green screen 18MHZ Hi- Res £86 + VAT **£99**

DM2112 12″ Green screen 15MHZ £66 + VAT **£75**

MICROVITEC CUB

1431 MS 14″ RGB Normal Res Colour £173 + VAT **£199**

1451 MS 14″ RGB Medium Res Colour £251 + VAT **£289**

1441 MS 14″ RGB High Res Colour £417 + VAT **£479**

MICROVITEC FOR QL

1451 14″ Medium Res Colour. Specially designed for Sinclair QL £239 + VAT **£275**

MITSUBISHI

High Res Monochrome etched antiglare green screen IBM/BBC Compatible £86 + VAT **£99**

ACORN

BBC MICROCOMPUTER SYSTEM

WE ARE AN OFFICIAL BBC COMPUTER DISTRIBUTOR

DEALER ENQUIRIES ARE WELCOMED

Acorn Electron £199 INC VAT

Free Cassette Recorder with every Electron plus 5 software titles

APPROVED ECONET SERVICE CENTRE

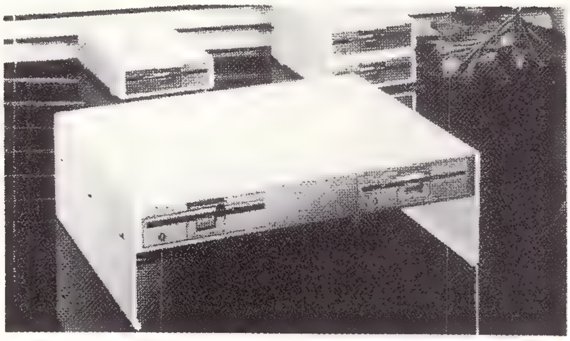
WE STOCK A LARGE RANGE OF SOFTWARE FOR BBC MICRO INCLUDING ACORNSOFT, BBC SOFTWARE, LONGMANS SOFTWARE, PLEASE SEND LARGE STAMPED ADDRESSED ENVELOPE FOR FULL DETAILS.

AKHTER COMPUTER GROUP

28/29 BURNT MILL HARLOW, ESSEX CM20 2HU U.K.
Tel. HARLOW (0279) 443521 Telex: 818894 AKHTER G

DISC

100% BBC COMPATIBLE MITSUBISHI AND TEAC SLIMLINE DISK DRIVES



These drives are supplied ready cased with all the necessary cables formatting program and User Guide
There are some very useful utilities included on formating disc e.g.

- * DISASSEMBLER: This is 6502 machine code disassembler
- * DUP: To copy and rename a file on disc
- * FORMAT: Formating progam for 40 & 80 tracks
- * FREE: This utility provides a disk usage analysis
- * MDUMP: Enables you to display and modify any part of BBC memory
- * MERGE: Merge a number of text files into one file
- * RELOCATE: Downloads a basic program to &E00
- * SDUMP: Screen dump for EPSON In all graphic modes
- * VERIFY: Verifies every sector on a disk
- * MENU: A flexible menu program

PRODUCTS

BBC Microcomputer Model B	£348	+ VAT	**£399**
BBC Mod B - disk interface	£409	+ VAT	**£469**
BBC Mod B - Econet interface	£389	+ VAT	**£447**
BBC Mod B - disk and Econet interfaces	£450	+ VAT	**£517**
BBC Compatible 100K disk drive	£86	+ VAT	**£99**
BBC Compatible dual 800K disk drive	£312	+ VAT	**£359**
Acorn Z80	£347	+ VAT	**£399**
Acorn 6502 Second Processor	£173	+ VAT	**£199**
Acorn Bit stick	£327	+ VAT	**£375**
Acorn IEE Interface	£282	+ VAT	**£325**
Acorn Electron plus 1 interface	£52	+ VAT	**£60**
BBC Prestel Adaptor	£115	+ VAT	**£132**
BBC Telext receiver (Aug)	£196	+ VAT	**£225**
BBC cassette recorder and lead	£30	+ VAT	**£35**
Disk interface kit (free fitting)	£89	+ VAT	**£103**
Mod A to Mod B upgrade kit	£70	+ VAT	**£80**
Fitting charge for A to B upgrade kit	£20	+ VAT	**£23**
16K memory upgrade kit	£30	+ VAT	**£34**
Games paddles	£17	+ VAT	**£19**
User Guide	£10		
Advanced User Guide	£12.95		
Econet Guide	£ 7.50		
Econet interface (free fitting)	£60	+ VAT	**£69**
Speech interface (free fitting)	£47	+ VAT	**£54**
BBC disk manual - formating disk	£30	+ VAT	**£34**
Parallel printer cable	£10	+ VAT	**£11**
BBC word processor (view)	£52	+ VAT	**£59**

YOUR CONTACT AT AKHTER
Tel: 0279 443521 (12 lines)

		EXT
DEALER/BULK ENQUIRIES	HAMAYUN MUGHAL	202
TELEPHONE ORDERS	CARON ANDREWS	210
DEALER ORDERS	JULIA ALLUM	209
EXPORT ENQUIRIES	MOHAMAD EDIB	201
TECHNICAL SUPPORT	ALAN LAFFOLEY	207
ACCOUNTS	JULIE AMBLER	211
LITERATURE REQUEST	JOHN MAULE	201

ORDERING INFORMATION

We accept official orders from UK Government and Education establishments. Carriage is £2.50 + VAT (UK only) for normal delivery. If express delivery is required please add £8.00 + VAT per parcel. We accept telephone orders on Barclay and Access card please ring (0279) 443521 (10 lines). all cheques made payable to "AKHTER INSTRUMENTS".

N.B. All prices are subject to change without notice and are rounded up to the nearest pound

OPENING HOURS: MON-FRI 9am-6.30pm. SAT 10am-5pm.
We welcome callers, no parking problems.

DRIVES

Single drive 100K 40 trks single sided	£86	+ VAT	**£99**
Dual drive 200K 40 trks single sided	£164	+ VAT	**£189**
Single drive 200K 40 trks double sided	£138	+ VAT	**£159**
Dual drive 400K 40 trks double sided	£260	+ VAT	**£299**
Single drive 400K 80 trks double sided	£152	+ VAT	**£175**
Single drive 400K 40 80 trks switchable DS	£155	+ VAT	**£179**
Dual drive 800K 80 trks double sided	£303	+ VAT	**£349**
Dual drive 800K 40 80 trks switchable DS	£312	+ VAT	**£359**
Dual Drive 800K 40 80 trks + PSU + built in monitor stand	£373	+ VAT	**£429**

All above drives are low power slimline (0 3 A typ at + 12v and 0 4 at + 5v per drive) Normally extra power supply is not required. The BBC Computer power supply is designed to drive to low power drive (IT IS NOT DESIGNED TO DRIVE INTERNAL ROM BOARD)

SS DD disketts (10 Box)	£18	+ VAT	**£20**
DS DD disketts (10 Box)	£23	+ VAT	**£26**

BUSINESS SYSTEMS

COMPLETE BUSINESS PACKAGE

This system is based on 16 Bit 8088 Processor 128K RAM, 2X730K Floppy Disc Drives, High Res Monitor, fast (160cps) Dot Matrix Printer, Wordstar Wordprocessor, Calcstar Spreadsheet Program, complete integrated Accounts package consisting of Sales Ledger, Purchase Ledger, Nominal Ledger, Invoicing, Stock Control, Payroll and mailing list.
Complete turnkey system at an unbelievable price.

Delivered Only £1495 + VAT **£1719**
Delivered and Installed plus ½ day training £1595 + VAT **£1834**

APRICOT PC

"Portable Executive Computer" 16 Bit Micro. 256K RAM up to 1.44 megabytes flopy disk storage. 3½" Sony disks. Portable brief case styling. Modem with auto dialler (optional) hard disk optional. Vast software library (compatible with Sirius 1).

Apricot with Double Drive, Monitor and ***Free Printer*** £1790 + VAT **£2059**

APRICOT XI

As above but with 10MB Winchester Drive and Single 315K Drive plus Superwriter, Supercalc and ***FREE JUKI 6100 Printer***

£2995 + VAT **£3444**

SANYO PROFESSIONAL COMPUTER

SANYO 550

16 Bit Micro 128K RAM expandable to 256K. Single or Double Disk drive built in full colour graphics (640 x 200 pixels in 8 colours) IBM compatible. Free software. Sanyo MBC 550 128K RAM single drive and free software including Wordstar and Calcstar

£749 + VAT £862

SANYO 550-2

As 550 but with Dual Drive 2 x 160K

£849 + VAT **£976**

SANYO 550-360

As 550 but with 2 x 360K Drives

£999 + VAT **£1149**

SANYO 550-730

As 550 but with 2 x 730K Drives

£1049 + VAT **£1206**

SANYO 555

Sanyo MBC555 128K double drive and free software including Wordstar, Calcstar, Inforstar, Datastar etc.

£999 + VAT £1149

SANYO 555-360

As 555 but with 2 x 360K Drives

£1249 + VAT **£1436**

SANYO 555-730

As 555 but with 2 x 730K Drives

£1299 + VAT **£1494**

SANYO SYSTEMS INCLUDE FREE HIGH RES GREEN MONITOR

WORD PROCESSING

COMPLETE SYSTEMS FROM £650 + VAT

BBC 1: BBC Micro Model B, View (or Wordwise) Wordprocessor, Quendata 20 CPS Daisywheel Printer, High Res Green Monitor, Cassette Recorder plus 10 cassettes and all the necessary cables £650 + VAT = **£747.50**

BBC 2: BBC Micro Model B + Disk Interface, View (or Wordwise) Wordprocessor, 100K Disk Drive, High Res Green Monitor, Quendata 20 CPS Daisywheel Printer, 1 Box of Disks and all the necessary cables
£799 + VAT = **£918.85**

BBC 3: Same as System BBC2 but with 400K Drive
£875 + VAT = **£1006.25**

BBC 4: Same as System BBC 2 but with 400K Drive and JUKI 6100 Daisywheel Printer
£975 + VAT = **£1121.25.**

BBC 5: BBC Model B + Disk Interface, View (or Wordwise) Wordprocessor, 800K Dual Disk Drive (Mitsubishi), High Res Green Monitor, JUKI 6100 Daisywheel Printer, 1 Box (10) of 80 Track DS discs and all necessary cables £1145 + VAT = **£1316.75.**

SAN 1: Sanyo MBC 550 Series 16 Bit Microcomputer, 128K Ram, Dual 160K drives (2 x 160K), High Res Graphics (600 x 200 pixels in 8 colours), JUKI 6100 Daisywheel Printer, High Res Green Monitor, 1 Box of 10 discs, Wordstar Wordprocessor, Calcstar spreadsheet and all the necessary cables £1175 + VAT = **£1351.25**

SAN 2: Same as SAN 1 but with Dual 360K Drives (2 x 360K)
£1345 + VAT = **£1546.75**

SAN 3: Same as SAN 1 but with Dual 720K Drives
£1395 + VAT = **£1604.25**

SAN 4: Sanyo MBC 555 Series 16 Bit Microcomputer, 128K Ram, Dual 160K Drives (2 x 160K), High Res Graphics (600 x 200 pixels in 8 colours) JUKI 6100 Daisywheel Printer, High Res Green Monitor, 1 Box of 10 discs, Wordstar, Wordprocessor, Calcstar spreadsheet, Mailmerge, Spellstar (dictionary), Datastar (database), Reportstar plus all the necessary cables
£1295 + VAT = **£1489.25.**

SAN 5: Same as SAN 4 but with Dual 360K Drives
£1475 + VAT = **£1696.25**

SAN 6: Same as SAN 4 but with Dual 730K Drives
£1525 + VAT = **£1753.75**

If you require High Res Colour Monitor instead of High Res Green Monitor in Sanyo Systems please add £320 + VAT = £368 to the above prices.
***128K RAM Upgrade for all above Sanyo systems (makes a total of 256K RAM) £150 + VAT = £172.50 including fitting.**

HEMMINGS ELECTRONICS LTD.

DEPT. EK
16 BRAND ST
HITCHIN
HERTS SG5 1JE

Tel: (0462) 33031
Shop open Mon. - Sat. 9 a.m. - 5.30 p.m.
Closed Tuesday afternoon

Professional quality electronic components, brand new and fully guaranteed. Mail order by return of post. Cash/Cheque/POs or Banker's Draft with order, payable to Hemmings Electronics Ltd. Official orders from schools, colleges and universities welcome. Trade and export enquiry welcome. P.&P. add 60p to all orders under £10. Telephone your credit card orders, using our 24-hr.Ansaphone service. Please send SAE for full price list.
VAT — All prices exclusive of VAT — Please add 15% to total cost including P.&P.
No VAT on export orders or books.

COMPUTER ICs

6502	350p
6800	290p
68B00	450p
6802	345p
6809	750p
6809E	996p
6810	120p
6821	230p
68B21	350p
6840	390p
68B40	500p
6844	1295p
6845	795p
6850	140p
6852	250p
6854	880p
6875	490p
8T26A	120p
8T28	120p
8T95	110p
8T96	110p
8T97	110p
8T98	110p
8035L	600p
8039L	CALL
8080A	360p
8202A	£25
8216	100p
8224	160p
8226	195p
8228	250p
8237A	£14
8251	600p
8255A	750p
8255	650p
8257	650p
8259	650p
8279	650p
75107	90p
75108	90p
75110	88p
75112	160p
75182	95p
75450	85p
75451	50p
75452	50p
75453	72p
75461	40p
75491	70p
75492	70p
AY-3-1015D	300p
AY-5-1013A	300p
MC1488	75p
MC1489	75p
MC3459	265p
Z80ACPU	350p
Z80APIO	350p
Z80ACTC	350p
Z80ADART	650p
Z80ADMA	895p
Z80ASIO/O	895p

MEMORIES

Static RAM	
2114L-200ns	200p
6116P3-150nS	600p
6116LP3-150nS	CALL
Dynamic RAM	
4116-200nS	95p
4164-200nS	500p
MCM6665AP-20	550p
EPROM	
2708-450nS	300p
2716-450nS	300p
2532-450nS	380p
2732-450nS	380p
2764-250nS	750p
27128-250nS	CALL

BBC LIGHTPEN KIT

A complete kit of parts based on TIL81 phototransistor with instructions to build your own light pen. All you need to supply is a suitable Biro case. Plugs into 15pin D connector at rear of BBC. **£5.25**

BARGAINS OF THE MONTH

Bulk purchase enables us to offer the following items: —

*8 character fluorescent alpha-numeric displays — as used in Texas "Speak & Spell". Can be driven directly from CMOS at 15v. No high voltage supplies required. Complete with data... **£2.25**

*TI-calculator switched keypad 5×8 matrix — no keytops or legends. **60p**

*Joystick mechanisms — 2 off 220K lin pots mounted in a joystick arrangement. . **£1.25**

APPLE II SINGLE CARD MODEM

*Does not require Serial Card
*All standards — 300 Baud, Bulletin boards. 1200 Baud, Prestel etc. CCITT & BELL tones.
*Auto dial and Auto answer.
*Terminal emulation/configuration program. User friendly and listable.
*Runs in any Apple II, II+ or IIe computer.
*Complete with software on disc. **£180**

8"DISC DRIVES

Secondhand 8" drives manufactured by Orbis Systems Inc. Model 74B. Single sided single density 400K. Supplied fully tested with interface details.
.... **£80**
Carriage **£3.50**

FULL range LSTTL CMOS in stock + large range of transistors & diodes

CRYSTALS

32 768KHz	100p	6 000MHz	180p
1 0000MHz	320p	6 1440MHz	180p
1 8432MHz	240p	6 880MHz	240p
2 0000MHz	225p	8 000MHz	160p
2 4576MHz	225p	10 000MHz	170p
3 0000MHz	240p	16 000MHz	190p
3 5795MHz	120p	18 432MHz	150p
3 6864MHz	240p	19 6608MHz	240p
4 000MHz	150p	20 000MHz	200p
4 1943MHz	190p	27 000MHz	170p
5 0688MHz	240p	48 000MHz	170p

PCB TRANSFERS

Make your own Printed Circuit Boards with Alftac Resist PCB Transfers

★ Draw your artwork on 0 1" grid
★ Transfer to copper board using carbon paper
★ Burnish the Alfac transfers to the board using a spatula using carbon marks to assist in accurate alignment
★ Use Alfac chemical eraser to correct mistakes
★ Etch in Ferric Chloride

EC900/1 0 1" Edge Connector
EC902/1 0 156" Edge Connector
EC908 0 063 Pads
EC910 0 094" Pads
EC911 0 189' Pads
EC940 0 016" Lines
EC941 0 031' Lines
EC942 0 039' Lines
EC943 0 049' Lines
EC944 0 061' Lines
EC945 0 079' Lines
EC946 0 100 ' Lines
EC947 0 124' Lines
EC950/1 0 031 90° Bends
EC951/2 0 061 90° Bends
EC951/1 0.031" 30°, 45°, 60° Bends
EC952/2 0 061 ' 30°, 45°, 60° Bends
EC960/1 TO-5 Transistor Pads
EC993/1 IC Pads
EC997/1 IC Pads with tracks between pads

5 identical sheets in sealed pack	**250p**
Individual sheets	**54p**
Spatula AR4 for burnishing	**45p**
Alfac Chemical Eraser	**40p**

Alfac Precision Grids: Polyester film, matt finish 0.14 mm thickness, 20 lines/in
A4 **110p**; A3 **220p**

Double Sided Fibreglass Board 1/16' thickness, 1oz Copper
5 '×4" **35p**; 5"×8' **60p**

Dalo Etch Resist Pen **110p**
Ferric Chloride Crystals Dissolve in 1/2 Litre Water **110p**

LIQUID CRYSTAL DISPLAY MODULES

PCIM177 Frequency Counter 5 Digits, 0 35" FM, SW, MW, MHz, KHz Annunciators, Sample and Hold Capability, Reset Capability 25 Selectable IF Offsets, Prescaler Available, Incandescent Backlighting, Option Supply Voltage 5v, Operating Current 4mA **1950p**

PCIM 176 Digital Voltmeter, .3½ digits, 0 5", +, and Decimal Point, 200mV Full Scale Input, True Differential Input, Guaranteed 'O' Reading, Single 9v Operation, Power Consumption 20mW, Accuracy 0 15%, +/ 1 Count, Temperature drift 80ppm/C, Low Battery Indicator, Incandescent Backlighting **1950p**

Both Modules are supplied with a data sheet

BBC MODEL B EPROM PROGRAMMER

The Zonix PP1 Eprom Programmer is mains powered and plugs into the 1 MHz bus.
The unit will program the following Eproms: 2716, 2732, 2732A, 2764, & 27128.
Software is provided on tape or disc — please specify tape or 40/80 track disc.
Utilities provided are: Examine, Memory, Move Memory, Load Memory from disc or tape, Save Memory & Fill memory.

With standard 28 pin Socket	£67.50
Optional 28 pin ZIF Socket	£ 8.00
P&P	£ 1.50

STOP PRESS

IBM PC MEMORY UPGRADE KITS 128 K CHIP SET IN STOCK NOW £95 + VAT

TRANSISTOR INVERTERS

Professional quality, british made 150-1000 Watts available 12 V or 24 V DC in 240 V AC out.
A range of top quality inverter suitable for a wide range of applications: Home, Caravan, Boats, Farming, Garage, Camping Power Cuts etc.
Suitable for use with TV, Hi-Fi, Video Electric Drills, Domestic Appliances, Lighting (Filament and Fluorescent).

SPECIFICATIONS:
Models Available
150VA/12V 15A full load
500VA/12V 45A full load
625VA/24V 30A full load
1000VA/24V 50A full load
Typical off load current is 0.5 to 1.5A.
Waveform Squarewave 50 Hz
Case (Maximum dimensions)
150VA 31 × 23 × 13 cm
500VA 42 × 26 × 19 cm
625VA 42 × 26 × 19 cm
1000VA 42 × 26 × 19 cm
Case Material heavy duty steel
Safety features electronic overload cutout

PRICES	
150VA/12V	£ 95.00
500VA/12V	£170.00
625VA/24V	£170.00
1000VA/24V	POA
Carriage	£ 4.00

Please allow 14 days for delivery

COMPUTER INTERFACE CONNECTORS

IDC (SPEEDBLOCK TYPE)

	Header Plug 90 Pins	Socket with Strain Relief
10way	95p	90p
20way	145p	135p
26way	170p	165p
34way	200p	190p
40way	220p	200p
50way	240p	220p

RIBBON CABLE

10way Grey (IDC Type)	54p
20way Grey (IDC Type)	105p
26way Grey (IDC Type)	136p
34way Grey (IDC Type)	178p
40way Grey (IDC Type)	209p
50way Grey (IDC Type)	262p

DIL HEADERS (IDC type)
14pin **100p** 16pin **110p**
24pin **150p** 40pin **220p**

OTHER COMPUTER CONNECTORS

34way IDC disc drive PCB edge Connector 0.1"	340p
ZX81 23+23 0 1" Connector	200p
Spectrum 28+28 connector	230p
VIC-20 22+22 0 156" bus Expansion Connector	220p
Commodore 12+12 0.156" User port connector	160p

We also stock a wide range of other components: Aerosols, Batteries, Boxes, Cable, Capacitors, Connectors, Fuses, Heatsinks, Knobs, Meters, Opto, Pots, Resistors, Soldering Irons, Switches, Transformers, etc. VISITORS ARE WELCOME

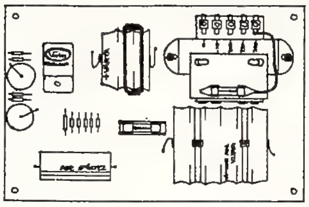
NEW THIS MONTH

Z917 PSU Panel 320 × 190 mm with MJ802 (30 A 100 V 200 W) on large heatsink 7 smaller heatsinks contain: 2 × 7805; 7812; 7905, 2 × MJE2955; 2SA473. Also 555, 3 × 4 A bridge rects, large smoothing caps, multiway plugs and sockets etc. Ex-equip working order. Only **£8.50**

DIP BOARD
Fibreglass DIP board 158 × 165 mm double sided with 58w 0.1" edge connector gold plated. Vero. **£3.50**

20 WAY RIBBON CABLE
Twisted and flat computer gradefor lower crosstalk Reformed into flat sections every 21" for IDC connectors. Only **70p** 21" or **£25** per 100ft reel.

3½ DIGIT LCD DPM
Type 900S self powered. Input range 4-20 mA. Contained in std DIN enclosure 96 × 48 × 100 mm............. .. .. **£15**



NI-CAD PANEL
177 × 114 mm PCB with one massive Varta Deac 57 × 50 mm ϕ rated 7.2 V 1000 mAH and another smaller Deac 32 × 35 mm ϕ rated 3.6 V 600 mA. The price of these Ni-cad stacks new is over £20. Also on the panel is a mains input charger transformer with two seperate secondaries wired via bridge rectifiers, smoothing capacitors and a relay to the output tags. The panel weighs 1 kgm. All this for just **£6.00**

NI-CAD BATTERIES
AA size **99p** each; C size **199p**; D size **220p**; PP3 size **395p**. SPECIAL!! 6 × D size. For only **£11.00**.

MINIATURE RELAYS
PCB mounting, DCPO size 20×15×15 mm. Available in 3, 9 or 12 V **£1** each

1 W AMPLIFIER
Z914 Audio amp panel 95×65 mm with TBA820 chip. Gives 1 W output with 9 V supply. Switch and vol control. Just connect batt. and speaker full details supplied.
Only **£1.50** 10 for **£12** 25 for **£25** 100 for **£75**

Z915 Stereo version of above 115×65 mm featuring 2 × TBA820M and dual vol control.
£3.50 10 for **£65** 24 for **£65** 100 **£200**

AM TUNER PANEL
Z916 For use with mono amp above. Neat panel 60×45 mm.
Only **£1.50** 10 for **£12.00**

NI-CAD CHARGER SCOOP!!
Ever-Ready model CH4, this charger will take up to 4 AA, C or D cells plus 2 PP3 if required. Smart two tone grey case 212×97×60 mm. Only **£7.95**

PCB MOUNTING NI-CADS
Much sought after 4 8 V 150 mA batts with PCB mntg tags on 25 mm pitch. Batt size 25 × 16 ϕ. Ideal for paralleling.
99p 10+ **85p** 25+ **70p** 100+ **60p**

STEPPING RELAY
Schrack 2 pole 10 way 24 V DC (works down to 15 V) only 39×20×24 mm. Connexions by 0.1" pitch edge plug. Special low price **£1.95**

PANELS
Z908 Panel 147×38 mm with 2 × TDA 1004 6W audio amp IC's **not soldered** in! so they can easily be removed. Also 1000 16, 1000 10 × 2, 470/16 elecs, ceramic discs, R's, also choke. (All easily removed) Stereo Amp? Only **£3.00** (IC's cost £4 ea)

Z909 Another board which escaped the clutches of the flow solder machine — 103×39 mm, this is an RF panel with a TDA1200 FM/IF chip & uPC1176C noise canceller + R's & C's inc. tants. Chips cost around **£8** together. Price for panel **£2.50**

Z910 139×39 mm, this panel has soldered in components — TCA4500A and TBA651R, AM radio with IF amp. Probably complete RF section of radio as IF's and trimmers are on board, + R''s C's etc **£2.50**

Z911 L shaped board 125 × 35 mm Looks like RF section of radio — BF194-5 etc + trimmers & IF's, but tuner is absent. **£1.00**

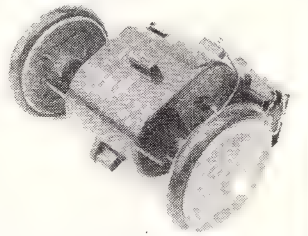
Z912 Same as Z909, only components have been soldered **£2.50**

Z913 Another L shaped panel 135×40 mm with non-soldered components including: BC549C × 2, BC208 × 3, BF241 × 2, BF194, coils, trimmers, R's, C's etc. **£1.00**

1984/5 CATALOGUE

84 page A4 size — Bigger, Brighter, Better, — more components than ever before! With each copy there's discount vouchers, Bargain List, Wholesale Discount List, Bulk Buyers List, Order Form and Reply Paid Envelope.
All for just **£1.00!!**
Winter Supplement due out November — Send large SAE for your free copy

"TREKKER"
Computer-controlled robot built around the gearbox described below. Complete kit of parts inc PCB, program listings for BBC (other micros soon) **£44.85**
20 W ribbon cable (min 3 m recommended — 5 m better) **£1.30/m**
SAE for illustrated leaflet.



MOTORIZED GEARBOX
These units are as used in a computerized tank, and offer the experimenter in robotics the opportunity to buy the electro-mechanical parts required in building remote controlled vehicles. Theunit has 2 × 3 V motors, linked by a magnetic clutch, thus enabling turning of the vehicle, and a gearbox contained within the black ABS housing, reducing the final drive speed to approx. 50rpm. Data is supplied with the unit showing various options on driving the motors etc. **£5.95**. Suitable wheels also available: 79 mm Dia plastic with blue tyre, drilled to push-fit on spindle. 2 for **£1.30** (limited qty). 75 mm dia aluminium disc 3 mm thick; drilled to push-fit on spindle. 2 for **68p**.

GREENWELD

The pack people!

More packs — more in them — more value! All our packs contain brand new, marked full spec components at a fraction of the normal price and offer constructors the widest range of parts at the lowest cost! How do we do it? By buying manufacturers end-of-run and surplus components. Because we purchase from many sources, we have an extremely wide range of top quality parts — too costly to sort hence the packs described below. Our larger packs are ideal for schools, groups or clubs.

ESTABLISHED FAVOURITES
K517 TRANSISTOR PACK — 50 assorted full spec marked plastic devices PNP NPN RF AF. Type numbers include BC114 117 172 182 183 198 239 251 214 255 320 BF198 255 394 2N3094 etc etc.
Retail cost **£7** + Special low price **275p**

K523 RESISTOR PACK — 1000 — yes 1000 ¼ and ½ watt 5% hi-stab carbon film resistors with preformed leads for PCB mounting. Enormous range of preferred values from a few ohms to a several megohms.
Only **250p** 5000 **£10** 20,000 **£36**

K520 SWITCH PACK — 20 different assorted switches — rocker, slide, push, rotary, toggle, micro etc.
Amazing value at only **200p**

K522 COPPER CLAD BOARD —All pieces too small for our etching kits. Mostly double-sided fibreglass, 250g (approx. 110 sq.ins)for **100p**

K530 100 ASSORTED POLYESTER CAPS — all new modern components, radial and axial leads. All values from 0.01 to luf at voltages from 63 to 1000!!
Super value at **£3.95**

K518 200 DISC CERAMIC CAPS — big variety of values and voltages from a few pF to 2.2 μF; 3 V to 3 kV **£1.00**

K503 20 ASSORTED POTENTIOMETERS — all types including single, ganged, rotary and slider**£1.70**

W4700 PUSH BUTTON BANKS — an assortment of latching and independent switches on banks from 2 to 7 way, DPCO to 6PCO. A total of at least 40 switches for **£2.95** 100 **£6.90** 250 **£14.00**

GREENWELD

Our shop has enormous stocks of components and is open from 9-5.30 Mon-Sat.
Come & see us!!

443E Millbrook Road
Southampton SO1 0HX
Tel (0703) 772501/783740
ALL PRICES INCLUDE VAT:
JUST ADD 60p P&P

Min Access order value £5. No min CWO value. Official orders from schools etc. welcome — min invoice charge £10

ALL PRICES INCLUDE VAT:
JUST ADD 60p P&P

elektor switchboard

WANTED - AF valves, HT & O/P transformers and any books on the subject. Also wanted - 19" rack cases; any condition. Any size. - Simon Fletcher, 5 Clegg Street, Kirkham, Preston, Lancs. Pr4 2TL, Tel. 0772 728262, ext 31180 Daytime.

WANTED: I am interested in electronics and am looking for penfriends. Ali Sharif, P.O. Box 14155-5431, Tehran, Iran.

AM interested in electronics telephone projects) and looking for en friends to swap various nformations. Contact me, Talat Mahmood, 10-D-Block Hostel, King Edward Medical College, ahore-7, Pakistan.

AM interested in designing and m looking for penfriends. - Reza Saeidipoor, P.O. Box 78, Masshad, ran.

UNIOR Computer and books -4 for sale. Phone offers to: ichfield (0543) 472669.

ELEQUIPMENT D61 'Scope, 2 hannel 10MHz £120 o.n.o. Leads nc. v.g.c. Phone Haywards Heath 56201 evenings.

VANTED Tekronix manual for ime Mark Generator, type 184, ewlett Packard Manual for ampling scope 185B - Tel. J.F. lawson 0742.552125.

ECHTRONICS 515A 10 MHz inge Beam £50. Eddystone 830 ommunication receiver £95. dvance SG66 LF Audio Generator 40. - Tel. Peterborough 235042.

SPECTRUM software for swap on tape. 300 programs currently available. Send your list and ask my list for swap. Hamid-Reza Tajzadeh, 4th floor, no.11, St. no. 3, Naarmack, Tehran 16479, Iran.

ATOM DISC interface (no. I.C.'s) with complete P.S.U. (5 & 12 V), ideal for DIY drive. £10 + postage. Tel. Andy, 01 854 2044, 6 to 7 p.m.

DIGITAL DESIGN program for the BBC B. Minimises 4 input Boolean equations, and graphically shows TTL Gate Cct. £3.50 P.O./cheque. Mr F. Botto, 106 Swansea Road, Garden Village, Gorseinon, Swansea, W. Glam., S. Wales, SA4 2HQ, U.K.

TANGERINE Microtan expansion boards required — Tanram, Tandos, PSU Mk 2, etc. Phone Tim: 01 529 2355, evenings.

LETS build a robot! If you are interested in this new exciting hobby please write with S.A.E. to: The Amateur Robotics User Club, C/O Alphonse Boehm, 51 Applegarth Drive, Ilford, Essex JG2 7TQ, England.

6809E MPU Chips 1-9 £4.50, 10+ £4 each. 74LS783/MC6883 sync. Addr. Mux. £5 each. All tested - Tel.: Nick Evenings/weekends, 0892 44070.

WANTED desperately Elektor issues Nos. E81-88, E92, E95, include with the price the postage for Airmail to: Johann Bothma, P.O. Box 3866, Petersburg 0700, South Africa.

CASED 88 Key Keyboards £16, Green VDUs £19, Valve Voltmeter £20, 25mm DPMs £16. Ring Peter, (01) 9796129.

SELL Service Manuals for Tektronix 535/545 scopes £8. Telequipment D52/S52 £5. Video Genie Micro £5. WD Radio 1152 £5. - Mr. Small, 8 Cherry Tree Road, Chinnor, Oxon, 0X9 4QY.

WANTED: Video equipment, Video camera, mixers etc. (working or not). Write to Odd Skramstad, Konduktprvn 17, 2200 Kongsvinger, Norway.

DISK Drive Siemens 5¼ drive excellent condition £95. o.n.o. Tel. 0865 750600 evenings and weekends.

SCOPE Advance 0515A single trace £30. Modern Teleprinter ITT 2300 £40. Tektronix type D Plug in £25. - A. Stobbe, 8 Illston Place, Weland Est., Dogsthorpe, Peterborough, PE1 4UY. Tel. 0733 40301.

FOR SALE FM/AM Sig Gen. TF995 Marconi counter TF2414 Muirhead oscillator + lots of gear - $100 or exch. computer, w.h.y. - Tel. 061 7232954.

19" RACK Cabinet new £30. Intelekt £15. ASCII Keyboard £10. Dynamic RAM needs RAM chips £10. 64k PCB + CON £5 all o.n.o. - D. Cressey, 9 Fairhurst Street, Central, Blackpool.

48k SPECTRUM, INTERFACE 1, 2 Microdrives 5 Cartridges, RS232C Cable, Fuller Keyboard, Lightpen and tape s and Mags. Sell - £230. - Mr. D. Snowden, 124 Walpole Road, S. Woodford, London E18 2LL, Tel. 01/5040565.

FOR MICROBEE: Z80 Disassembler on tape 1200 and 300 Baud. Price $25 + shipping. - Peter A. Fredriksen, Sjaellandsgade 25.1, DK-7800 Skive, Denmark. Tel. Int.: +457527666 (evenings).

USED: EPROMS: 8 2516, 9 2716 + unused basic 2 & used Econet ROMS for BBC Micro. Sell or swop any firmware for BBC or w.h.y. - Blyth (0670) 361094 Ask for Bill.

UNEMPOYED person requires any electronic components, test equipment, books, etc. Could pay small charge. Tel. 0253 45756.

FREE advertising for our readers!

ules:

Private advertisers only. No trade, no business.

Full address or private telephone number; no post office boxes.

Items related to electronics only. Software only when related to Elektor computer ystems.

Maximum length: 114 characters — letter, numeral, comma, space. etc. (not ncluding address and/or telephone number).

One advertisement per reader per month. To enforce this rule, a switchboard voucher vill be printed each month.

Elektor cannot accept responsibility for any correspondence or transaction as a esult of a 'switchboard' ad, nor as a result f any inaccuracy in the text.

Ads will be placed in the order in which they are received.

We reserve the right to refuse advertisements, without returning them.

I am a private reader. I have read your rules and I enclose a valid switchboard voucher. Please place the following advertisement, free, in the next available space.

BLOCK CAPITALS PLEASE — ONE CHARACTER TO EACH BOX

Name and address:

Send to:

Elektor switchboard,
Elektor House
10 Longport
Canterbury CT1 1PE

All advertisements *must* include the voucher printed here. They must be post-marked within the month indicated.

elektor switchboard JANUARI 1985

back number service

E34, February 1978
Infra-red Light Gate/Throwing Some Light on LEDs/Formant — the Elektor Music Synthesiser (8)/Slow on/off/CMOS Function Generator/Zener Tester/Development Timer/Experimenting with the SC/MP (4).

E38, June 1978
1/4 GHz Counter/Constant Amplitude Squarewave to Sawtooth Converter/Servo Polarity Changer/ Monopoly Dice/ Mini Counter/Digital Clock Using the SC/MP/Programmable Call Generator/TV Sound Modulator/ Automatic Stereo Switch/Traffic Light Controller/Easy Music.

E54, October 1979
Touch Tuning/Battery Saver/Impedance Bridge/New Programs for the SC/MP/Digital Rev Counter/Digifarad/Short-interval Light Switch/PCB for Variable Fuzz Box/Gate-dipper/Strain Gauge/I Played TV Games/Programmable Sequencer.

E55, November 1979
Topamp/Flash Sequencer/Electronics the Easiest Way/Remote Control Motor Switch/ Home Trainer/Fuel Economiser/ I Played TV Games (2)/Shortwave converter/Ionosphere/Low Voltage Dimmer/I See your Point/Servo-controlled Motor.

E58, February 1980
Aerial Booster/Fet Opamps in the Formant/TV Interference Suppression / Elektor Vocoder (2)/Aerial Amplifiers/Digisplay/ Analogue Delay Technology/Extending the 1/4 GHz Counter/ Digital Thermometer.

E65, September 1980
8K RAM +4.8 or 16K EPROM on a Single Card/Precision Power Unit/Electronic Linear Thermometer/The Josephson Computer/VOX Printed Circuit Board/Ejektor: Measuring Multipath/High Speed Readout for Elekterminal/Musical Box/Electrolytology/Curve Tracer/Using the Vocoder.

E66, October 1980
Programmable Slide Fader/Touch Doorbell/Switched Capacitors/ More TV Games/The Junior Computer Memory Card/Remote Control Slide Projector/Video Pattern Generator/LCD Tuning Scale/Dual Slide Faders.

E67, November 1980
An r.p.m. Indicator as an Economy Guide/Draught Detector/How to Recycle Dry Cell Batteries/Energy Saving Knowhow/Simple Fuel Economy Meter/Automatic Pump Control /Long Life Technique in Light Bulbs/Automatic Curtain Control/Fridge Alarm/Know the ins and outs of your Central Heating System/Energy Saving Motor Control/Coffee Machine Switch/ Operational Hours Counter.

E68, December 1980
Canned Circuits: 23 of the best entries which include Midnight Raid Detector/A 'Flash in the Can' / Canometer / Canine Defence.

E70, February 1981
Audio Power Meter/Noise Reduction / Process Timer / High voltage from 723 / Juniors Growing Up/The Voiced/Unvoiced Detector / Emergency Brake for the Power Supply/ 150 W DC to DC Converter for the Car/Low Noise 2 Metre Pre-Amp/2½ Digit DVM/Wagnephon.

E72, April 1981
Transistor Match-maker/Universal Power Supply/Intelekt/Humidity Sensor/Logic Analyser II/ Crystal-controlled Stroboscope/ Junior Cookbook.

E73, May 1981
Camping Clock / Frequency Doubler/The Fully Fledged Junior Computer/Talk to Computers/Choke Alarm/Bar Codes/ Logic Analyser/Waveform Generator/Sophisticated Software for the Junior Computer/Reading Bar Codes.

E77, September 1981
DFM + DVM/Revolution Counter/Digital Barometer/dB Converter/TV Games Extended/ Disco Lights Controller/QUAD ESL 63/Analogue LED Display/ Volt/Ammeter for Power Supplies/Chattering Chips/Transistor Ignition Update/Soldering Aluminium.

E89, September 1982
Gas Detector/Rapid Loading Games/The Elektor Connection/ Inductive Sensor / Darkroom Computer Part 1 / Applikator/ Home Telephone System/Synthesised Sound Animation/Time Receiver for the Rugby MSF/ Three Phase Tester.

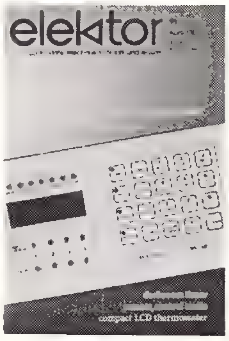
E90, October 1982
DSB Demodulator/L.C.D. Thermometer/Ultra Sonic Distance Measurement/Electrolytics Run Dry/Darkroom Computer Part 2/Short Wave Band Shifting for SSB Receiver/16 Channels with only Five ICs/Pre-amp for the SSB Receiver / Active Aerial / Transistor and IC Data.

E91, November 1982
Drum Interface/Talking Dice/ Model Train Lighting/Guitar Tuner/Cerberus/Floppy Disc Interface for the Junior/Cubular Bell/Mini-Organ Extension/ Kitchen Timer.

E93, January 1983
Milliohmmeter/accessories for the Crescendo power amplifier/ Darkroom computer tips/Chips for digital audio/3 A computer supply/Traffic-light control system / Tomorrow's music / Upper and lower case on the Elekterminal.

E94, February 1983
Prelude part 1/VAM — video/ audio modulator / Main beam dimmer/Prelude class A headphone amplifier/Fuse protector/ Acoustic telephone modem/ Double dice/Chips for digital audio part 2.

E96, April 1983
Low power digital thermometer/ MC/MM phono preamp/Membrane switches/Interlude/RC equalizer/7-day timer/controller/Junior program tester/Prelude (part 3)/Programmable darkroom timer/Talking clock extension.



E97, May 1983
Wattmeter/ASCII keyboard/Prelude p.s./Multitester/Maestro (part 1)/What is power?/Parallel-serial keyboard converter/Morse converter/78L voltage regulators . . and 79L/Morse decoding with the Z80A.

E99/100, July/August 1983
Summer Circuits Double Issue containing over 100 projects.

E101, September 1983
Video Graphics / Autotest / 64k on the 16k Dynamic RAM Card / high-speed CMOS / VDU Card / Personal FM / Precision Voltage Divider / Alarm Extension / Junior Synthesizer / Simple MOSFET Test.

E102, October 1983
Basicode-2 / Music Quantisizer / Solid-state Darkroom Lighting / High-voltage Regulator / Anemometer / Programmable Power Supply / Basicode-2 Interface for the Junior Computer / Electronic Voltage Regulator / Battery Eliminator / Transistor Selector / FSKleaner / EPROMmer using the Junior Computer.

E103, November 1983
Doorbell — or telephone — operated flashlight/Power Controller for Model Railways/ Decoupling in Digital Circuits/ CPU Card/Decimal to Binary Converter/Movement Detector/ Electronic two-tone Metronome/ Pseudo Stereo/Universal Terminal/Ultrasonic/Infrared Barrier/Trick Battery/Crescendo revisited.

E104, December 1983
64-way 2-dimensional Bus Board /MF/HF USB Marine Receiver/ LED Ornaments/Symmetrical Power Supply/Video Amplifier/ Locomotive Headlamp Reverser/ Frost Warning Device/Disco Phaser/Banking Program/NOV-RAM: Data Storage without Batteries/Bus Extension/ + Cumulative index 1983.

E105, January 1984
Gyrophone/How accurate is your watch? /Digital Cassette Recorder/Audio Signal Embellisher/Universal Active Filter/ from Thermometer to Thermostat/Audio Sleuth at work/Wind Direction Indicator/Z80 EPROM programmer/Home-made low-cost Wiring Probe/Address deding.

E106, February 1984
6502 Tracer/Diesel Tachometer/ Programmable Disco Display Lights/Video Combiner/Digitester with a difference/Reversing Buzzer/Memory timing/ Mating Logic Families/Capacitance Meter/Basicode 2 for Junior plus VDU Card/Constant Voltage Source/CS Chip Selekt/ Video Sync Box.

E107, March 1984
Petrol Saver/Triac Control Board /UHF Video and Audio Modulator/ GET & GO/Elabyrinth/ Varistor Protection Circuits/ Real-Time Analyser (part 1)/ Applicator/Tape Timer.

E108, April 1984
Optical Memories/Controlling the Floppy-disk Drive Motor/Pulse Generator/Using the Pulse Generator/Intelligent EPROM Eraser/ Z80 Simulator/Metronome Extension/Real-time Analyser, part 2/ Variable A.C. Power Supply/ Idlist/Chip Selekt/Tape Contents Detector.

E109, May 1984
Noise Squelch/Short-wave Pocket Radio/Floppy Tester/Switching Power Supply/Analytical Video Display/Aviary Illumination/How many Watts?/Mini Crescendo/a look at EXOR and EXNOR Gates/ EPROM Copier/Digital Cassette Recorder revisited/Real-time Analyser, part 3/RS423 Interface.

E110, June 1984
Portable Distress Signal/ZX Extensions/Disco Drum/Daisywheel Typewriter Printer Interface/Maximum and Minimum Memory/ Lead-acid Battery Charger/Wireless Microphone/Merging BASIC Programs/Echo Sounder/Versatile Audio Peak Meter.

E111/112, July/August 1984
Summer Circuits Double Issue containing over 100 projects.

E113, September 1984
E114, October 1984

Back numbers of Elektor currently available are detailed above, with a brief description of their contents.
Send for your copies now, using the pre-paid Order Card inside the back cover of this issue.
Prices are as follows: any one issue (except July/August) . . . . **£ 1.50**
additional issues, each . . . . **£ 1.30**
July/August (Summer Circuits) . . . . **£ 3.00**
Prices include postage and packing. Overseas orders requiring airmail postage add £ 1.50 per issue (£ 2.00 for July/August issue)
(Prices subject to change without notice)

REGULATORS

LM 317T Plastic TO220 variable .... **£ 1.00**
LM 317 Metal .... **£ 2.20**
7812 Metal 12v 1A .... **£ 1.00**
7805/12/15/24 plastic **50p**
7905/12/15/24 plastic **50p**
CA 3085 TO99 Variable regulator ... **£ 1.00**
LM 723 14 dil **50p**

EPROMS/MEMORIES

2764 Intel/Fujitsu 300ns **£ 6.50** 250ns **£ 7.00**
27128-300 nS .... **£ 18.00**
2716, 2708, 1702 ex eqpt. **£2.00** 10/**£17.00**
2732A-4 new .... **£3.50** ex eqpt. **£2.50**
2114 ex eqpt....... **80p** 4116 ex eqpt. **70p**
4164-150nS .... **£4.00** MC6810P**£1.00**

POWER TRANSISTORS

TIP 141, 142, 147 .... ea. **£ 1.00**
TIP 112, 125, 42B .... 2/**£ 1.00**
TIP 35B .... **£ 1.30** TIP 35C .... **£ 1.50**
SE9302100 V10 ADarl.simTIP121 .. 2/**£ 1.00**
2N3055 Motorola .... **50p** 5/**£ 2.00**
2N3055 Ex eqpt. tested .... 4/**£ 1.00**
Plastic 3055 or 2955 equiv. **50p** 100/**£30.00**
2N5302 NPN 30A 60V sim. 2N3771 ... **80p**
2N3773 NPN 25A 160V ... **£1.80** 10/**£16.00**

DISPLAYS

Futaba 4 digit clock fluorescent display FLT-02-8 also 5-LT 16 .... **£ 1.50**
Futaba 8 digit calculator fluorescent display 9 CT-01-3L .... **£ 1.50**
LCD Clock display 0.7" digits ...... **£ 3.00**
Large Clock display 1" digits .... **£ 3.00**
7 seg 0.3" display comm. cathode ... **50p**

MISCELLANEOUS

1.25" Panel fuseholders .... 5/**£1.00**
STAINLESS STEEL HINGES 14.5" by 1" open .... each **£1.00** 10/**£7.00**

QUARTZ HALOGEN LAMPS

A1/216 24 v 150 w .... **£ 2.25**
H1 12 v 55 w (car spot) .... **£ 1.25**

WOUND POT CORES

with adjuster unused
RM7 LA4245 .... 3/**£ 1.00**
RM8 LA4344 .... 2/**£ 1.00**
Mains transient Suppressors 245 V 3/**£ 1.00**
TOK KEY SWITCH 2 POLE 3 KEYS ideal for car/home alarms . **£ 3** 100/**£ 2.00**
12 v 1.2 w small wire ended lamps/ fit Audi/VW/TR7/Volvo/SAAB . 10/**£ 1.00**
14 v 0.75 w MES lamps .... 8/**£ 1.00**
Heat shrink sleeving pack .... **£ 1.00**
PTFE sleeving pack asstd. colours .. **£ 1.00**
250 mixed res. diodes, zeners ...... **£ 1.00**
Mixed electrolytic caps. .... 100/**£ 2.00**
ITT CASS. RECORD/PLAY AMP. + cct .... **£ 2.00**
Stereo cassette deck .... **£ 5.00**
Stereo cass. R/P head .... **£ 2.50**
Mono head .. **£ 1.00** Erase head .. **50p**
Thermal cut-out 50°C, 77°C or 85°C **70p**
Thermal fuse 121°C 240 v 15 A 5/**£ 1.00**
VERO pins fit 0.1" Vero .... 200/**£ 1.00**
Double sided PCB pins .... 200/**£ 1.00**
TO220 Micas + bushes .... 10/**50p** 100/**£ 2.00**
TO3 Micas + bushes 10/**50p**
Relays 240 v AC coil PCB mounting
2 pole changeover .... **£ 1.00**
3 pole changeover .... **£ 1.00**
Varley 24 v dc 4p c/o relay **80p**
Fig. 8 mains cassette leads ...... 3/**£ 1.00**
KYNAR wire wrapping wire 2oz reel .... **£ 1.00**
PTFE min. screened cable .... 10 m/**£ 1.00**
TOKIN MAINS RFI FILTER 250 v 15 A .... **£ 3.00**
TDK MAINS RFI FILTER 115 v 15 A .... **£ 1.00**
IEC CHASSIS PLUG/RFI FILTER 3 A**£ 3.50**
Epoxy potting compound 500 g ..... **£ 2.00**
Mercury tilt switch small .... **£ 1.00**
Min. rotary sw. 4p c/o 1/8" shaft .... 2/**£ 1.00**

Thorn 9000 TV audio o/p stage .. 2/**£ 1.00**
10M7 CERAMIC FILTER ... **50p** 100/**£ 20**
6M CERAMIC FILTER .... **50p** 100/**£ 25**
240 v AC FAN 4.6" SQUARE NEW .... **£ 5.50 (£ 1)**
240/115 v AC FAN 4.6" sq. NEW**£ 7.00 (£ 1)**
12 v DC Brushless fan reversible 2.5" sq. 2" deep QUIET .... **£ 9.00**
KLIPPON terminal block EKS 12/4 12 way 20 A term block .... 3/**£ 1.00**
BELLING-LEE 12 way block L1469 .... 4/**£ 1.00**
POTENTIOMETERS short spindle
2k5 10k 2M5 Lin .... 5/**£ 1.00**
500k lin 500k log long spindle .... 4/**£ 1.00**
40 kHz ULTRASONIC TRANSDUCERS ex. eqpt. NO DATA .... pair **£ 1.00**
Stick-on cabinet feet .... 20/**£ 1.00**
TO3 transistor covers .... 10/**£ 1.00**
transistor mounting PADS TO5/TO18 ..... **£ 3**/1K
DIL Reed Relay 2 pole N/O contacts **£1.00**

RECTIFIERS

120 v 35 A stud **50p**
12FR400 12 A 400 v small stud ... 4/**£ 1.50**
BY 127 1200 v 1.2 A .... 10/**£ 1.00**
BY 254 800 v 3 A .... 8/**£ 1.00**
BY 255 1300 v 3 A .... 6/**£ 1.00**
1 A 800 v bridge rectifier .... 4/**£ 1.00**
6 A 100 v bridge **50p**
10 A 600 v bridge .... **£ 1.50**
15 A 100 v bridge .... **£ 1.50**
25 A 200 v bridge . ea. **£ 2.00** 10/**£ 18.00**
25 A 400 v bridge ..... **£ 2.50** 10/**£ 22.00**

SCRs

MCR72-6 400 v .... **£ 1.00**
BTX95 800 v 15 A .... **£ 1.50**
35 A 800 v stud .... **£ 2.00**
70 A 500 v large stud .... **£ 3.00**
MCR106 equiv. 4 A 400 v **40p** ea 100/**£ 20.00**
2N5061 800 mA 60 v TO92 ...... 4/**£ 1.00**
TICV 106D .8 A 400 v TO92 3/**£ 1** 100/**£ 15.00**
MEU21 Prog. unijunction .... 3/**£ 1.00**

TRIACS diacs 25p

TXAL225 8A 400V 10mA gate .... 2/**£1** 100/**£35.00**
TXAL228 8A 400V isol. tab .... 2/**£1.00**
25A 400V ex eqpt. tested **£1.50**

CONNECTORS (EX EQPT. price per pair)

D' 9 way .. **£ 1.00** 37 way ...... **£ 2.00**
15 way .. **£ 1.25** 50 way ...... **£ 3.50**
25 way .. **£ 2.00**
covers .... ea **50p**
NEW 25way PCB skt .... **£ 1.00**
D9 PCB PLUG 90 deg. .... **£ 1.50**
0.1" d/sided edge connector, 32 way, ideal ZX81/SPECTRUM .... **£ 1.50**
0.1" d/sided pcb plug 24 + 25 way **£ 1.50**
2 pole sub min. connectors ideal radio control RS466/472/488/343 .... 5 pairs/**£ 2.00**

IDC CONNECTORS

25 way 'D' Plg/Skt 37 'D' PLUG ea. **£ 2.00**
20 way socket (BBC user port) ..... **£ 1.00**
26 way socket (BBC printer) .... **£ 1.50**
34 way socket (BBC disc drive) .... **£ 2.00**
40 way socket .... **£ 2.00**

IDC CARD EDGE CONNECTORS D/S EX-EQPT

34 way (fits disc drive PCB) .... **£ 3.00**
40 way (fits Centronics 739 PCB) ... **£ 3.00**
50 way .... **£ 3.50**

WIRE WOUND RESISTORS

W21 or sim. 2.5 W
10 of one value for .... **£ 1.00**
1R0, 2R0, 2R7, 3R9, 5R0, 10R, 12R, 15R, 18R, 20R, 27R, 33R, 36R, 47R, 120R, 180R, 200R, 330R, 390R, 470R, 560R, 680R, 820R, 910R, 1K, 1K15, 1K2, 1K3, 1K5, 1K8, 2K7, 3K3, 10K

W22 or sim. 6 watt
7 of one value for .... **£ 1.00**
1R5, 9R1, 10R, 12R, 20R, 33R, 51R, 56R, 62R, 120R, 180, 270R, 390R, 560R, 620R, 1K, 1K2, 2K2, 3K3, 3K9, 10K

W23 or sim. 9 watt
6 of one value for .... **£ 1.00**
R22, 1R0, 3R0, 6R8, 56R, 62R, 100R, 220R, 270R, 390R, 680R, 1K, 1K8, 10K

W24 or sim. 12 watt
4 of one value for .... **£ 1.00**
R50, 2R0, 10R, 18R, 47R, 68R, 75R, 82R, 150R, 180R, 200R, 270R, 400R, 620R, 820R, 1K.

PHOTO DEVICES

Slotted opto-switch OPCOA OPB815 .... **£ 1.30**
2N5777 .... **50p** 100/**£ 26.00**
TIL81 TO18 Photo transistor .... **£ 1.00**
TIL38 Infra red LED 2/**50p**
OPI2252 Opto isolator **50p**
Photo diode .... **50p** 6/**£ 2.00**
MEL12 (Photo darlington base o/c) .. **50p**
RPY58A LDR ...... **50p** ORP12 LDR **50p**
LEDs RED 3 mm or 5 mm ..... 12/**£ 1.00** 100/**£ 6.00**
GREEN + YELLOW 3 or 5 mm 10/**£ 1.00** 100/**£ 6.50**
FLASHING RED 5 mm .... **50p** 100/**£ 30**

DIODES

1N4148 .... 100/**£ 1.50**
1S3740 Germanium .... 100/**£ 2.00**
1N4004 or SD4 1 A 300 V ..... 100/**£ 3.00**
1N5401 3 A 100 V .... 10/**£ 1.00**
BA 157 1 A 400 V Fast recovery .... 100/**£ 2.50**
BA 159 1 A 1000 V Fast recovery .... 100/**£ 3.50**

MULTI TURN PRESETS

10R, 20R, 100R, 200R, 500R **40p**
2K, 5K, 22K, 50K, 100K, 200K

IC SOCKETS

8-pin 12/£1; 14-pin 10/£1.00; 18/20-pin 7/£1; 100/£12; 1k/£80; 22/28-pin 25p; 24-pin 25p; 100/£20; 1k/£100; 40-pin 30p; 16-pin 12/£1; 100/£6

TRIMMER CAPACITORS small

GREY 1.5-6.4 pF
GREEN 2- 22 pF .... 5 for **50p**
GREY larger type 2-25 pF .... 5 for **50p**

SOLID STATE RELAYS NEW 10A 250v AC

zero voltage switching control voltage 8-28 V DC .... **£ 2.50**
VARIAC 0 to 130 V 6 A new uncased .... **£ 6.00**

POLYESTER/POLYCARB CAPS

10n/15n/22n/33n/47n/68n 10 mm rad .... 100/£ **3.00**
100n 250 V radial 10 mm .... 100/**£ 3** 1000/**£ 25.00**
1 μ 250 V Polyester C280 ..... 5/£ **1.00** 100/£ **10.00**
1μ5 P/carb 15 mm rad ... 100/£ **5.00 (£1)**
2μ2 160 V rad 28 mm . 100/**£ 10.00 (£1.50)**
470n 250 V AC X rated rad ... 4/£ **1.00**
33n 250 V AC X rated rad 15 mm10/£ **1.00**
10n 250 V AC X rated rad 10 mm10/£ **1.00**
100n 600 V sprague axial .... 10/**£ 1.00** 100/**£ 6.00**

BEAD THERMISTORS

GLASS BEAD NTC Res 20'c **80p**
250R, 1K2, 50K, 220K, 1M4
R53 Thermistor **£2.00**

BEAD TANTALUM CAPS

47 μ 3 V, 68 μ 6 V .. 12/**£ 1.00** 100/**£ 6.00**
2μ2 20 V .... 8/**£ 1.00** 100/**£ 8.00**

SMALL AXIAL CERAMIC CAPS 50V

15 p, 18 p, 22 p, 27 p, 33 p, 47 p, 68 p, 82 p, 470 p, 1 n, 10 n (25 V) .... 100/**£ 3.00**

MONOLOTHIC CERAMIC CAPS

100 n 50 V 100/ . **£ 5** 10 n 50 V 100/. **£ 3**
470 n 50 V 100/ . **£ 7** 1μF 50 V 100/ . **£ 8**

STEPPER MOTOR 4 PHASE 2 9 V WINDINGS .... £ 3.50 10/£ 35

KEYTRONICS

332 LEY STREET, ILFORD, ESSEX IG1 4AF.
Shop open Mon-Sat 10am-2pm
TELEPHONE: 01-553 1863

MIN ORDER £2.50 OFFICIAL ORDERS WELCOME
UNIVERSITIES COLLEGES SCHOOLS GOVT DEPARTMENTS
P&P AS SHOWN IN BRACKETS (HEAVY ITEMS)
50p OTHERWISE (LIGHT ITEMS)

ADD 15% VAT TO TOTAL

ELECTRONIC COMPONENTS BOUGHT FOR CASH

elektor BUYERS GUIDE

TRY US FIRST
for all
ELECTRONIC COMPONENTS AND GENERAL
ELECTRICAL SUNDRIES

J.T.FILMER

82 DARTFORD ROAD DARTFORD
Telephone: 24057

L.F. HANNEY

77 Lower Bristol Road, Bath, Avon.
Tel. 0225-24811
Your electronic component specialist for Avon,
Wilts. & Somerset.
Closed Thursdays

BRADLEY MARSHALL LTD.

SPECIALIST ELECTRONIC COMPONENT DISTRIBUTORS
325 Edgware Road, London W2 1BN.
Tel. 01 723 4242
Telex 295441
Stockists of Texas, National, Thomson (CSF),
Siemens, Crimson Elektrik, Thandar, RCA,
Bahco Tools Ltd., and many more.

D. P. HOBBS (NORWICH) LTD.

(G 6KOC) 13 ST. BENEDICTS STREET (G 3HEO)
NORWICH, NORFOLK NR2 4PE
Telephone 615786
Electronic component specialists
Amateur radio equipment
P/exchanges welcome — Access. B/Card
Open 9 a.m. — 5.30 p.m. Mon. — Sat.
Closed Thursdays

ELECTRO SUPPLIES

NORTHERN COMPONENT SPECIALISTS
Test equipment, Computers, Peripherals

263 DEANSGATE,
MANCHESTER.
061-834-1185

also at SHAWCLOUGH ROAD,
WATERFOOT
ROSSENDALE BB4 9JZ.
0706 -215556

GARLAND BROS. LTD

GB ELECTRONIC COMPONENTS

Electronic Components Specialists
Chesham House, Deptford Broadway, London,
SE8 4QN
Telephone: 01-692 4412

DIRECT ELECTRONICS

627 Romford Road
Manor Park
London E12 5AD
Tel. 01 553 1174
ELECTRONIC COMPONENT SPECIALISTS

Marshall's

Electronic Component Distributors
85 WEST REGENT STREET
GLASGOW G2 2QD
TELEPHONE 041 332 4133 4 5

Judge us by the company we keep —
Siemens, Texas, National, Mullard, Leader, ITT,
Global Specialities, Piher, Sinclair/Thandar, Greenwood,
Arrow, Antex, Sifam, Vero, Motorola

STEVE'S ELECTRONICS SUPPLY COMPANY LTD.

35 Castle Arcade, Cardiff CF1 2BW, Wales.
Tel. 0222 41905

peats

the world of electronics
Tel. 749973/4

25/26 Parnel Street,
Dublin,
Republic of Ireland

FOR COMPUTERS, ELECTRONIC
AND VIDEO GAMES, COMPONENTS.
(ATARI SPECIALISTS)

ETESON ELECTRONICS

E•E•

WE STOCK. — A WIDE RANGE OF COMPONENTS
CASES & MULTIMETERS
VERO PRODUCTS
BABANI BOOKS
SOLDERING IRONS, TOOLS,
& MUCH MUCH MORE

15B Lower Green Poulton-le-Fylde BLACKPOOL Tel. 885107
Electronic Component Specialists

PROGRESSIVE RADIO

'THE ELECTRONICS SPECIALISTS'
Aerials/Components/Ham & CB Radio — a fully comprehensive range.
93 Dale Street, Liverpool L2 2JD.
Tel. 051 236 0982
Also at 47 Whitechapel, Liverpool.
Tel. 051 236 5489

BONEX LTD.

102 CHURCHFIELD ROAD, ACTON,
LONDON W3 6DH — 01 992 7748

Toko coils + filters + chokes and inductors + Ifts.
Moulded coils linear TTL CMOS XTAL filters
Helical and ceramic filters RF transistors
Radio communication IC's Toko block filters

Not just a component shop but a whole lot more.
Trade & OEM qtys. available ex stock.

SPECTRON ELECTRONICS LTD. MANCHESTER

ELECTRONIC
COMPONENTS,
TEST EQUIPMENT, ELEKTOR
PCBS AND BOOKS TECHNICAL BOOKS.
7 OLDFIELD RD SALFORD TEL: 061 834 4583

microprocessor HARDWARE

Are you looking for a terminal for your microprocessor. . .? Or maybe a memory extension? Is your cassette interface too slow or just not good enough? Computer capacity underestimated? How do you program your (E)PROMs? All these and many other questions are answered in this microprocessor hardware book in clear and easy-to-understand language.
The heart of every personal computer is the microprocessor and only a limited number of these are in common use. This book describes a range of peripheral equipment which can be used with an assortment of personal computers using the 6502, 6809, Z80 or 8080 microprocessor. this is obviously not an easy matter, but the book explains all that is necessary to enable the systems to be applied with the minimum number of circuit modifications.
From Elektor Publishers Ltd. Price £7.90 + p&p 55p U.K./p&p outside U.K. £1.10. Please use the order card in this issue.

COMPUTER WAREHOUSE

1000's OF BARGAINS FOR CALLERS

THE 'ALADDIN'S' CAVE OF COMPUTER AND ELECTRONIC EQUIPMENT

HARD DISK DRIVES

Fully refurbished **DIABLO/DRE** series 30 2.5 Mb disk drives **DEC RKO5, NOVA, TEXAS** compatible

Front load. Free stand or rack mount	*£550.00*
Exchangeable type (via lid removal)	*£295.00*
me3029 PSU unit for 2 drives	*£125.00*
DIABLO/DRE 44-4000A/B 5+5 ex stock from	*£995.00*

1000's of spares for S30, 4000, 3200, HAWK ex stock
Plus in house repair, refurbishing service.
Call for details or quotation

EX STOCK INTEGRATED CIRCUITS

OVER 100,000 ITEMS INCLUDING:
Intel D8085AH-2 **£25.00** D8271 **£65.00**
D8202 D8257-5 8255 D3002
2732 EPROM SPECIAL fully guaranteed
450ns £3.75, 350ns £4.00, 300ns £4.50

HOT LINE DATA BASE

DISTEL©

THE **ORIGINAL FREE OF CHARGE** dial up data base 1000's of stock items and one off bargains.
ON LINE NOW – 300 baud, full duplex CCITT tones, 8 bit word, no parity.

01-679 1888

STILL IN STOCK

FP1500 Heavy Duty 25 cps daisy wheel RS232 interface, bi directional printers, **Brand New** at £499.00
CALL FOR MORE DETAILS

COMPUTER 'CAB'

All in one quality computer cabinet with integral switched mode PSU, Mains filtering, and twin fan cooling. Originally made for the famous **DEC PDP8** computer system costing thousands of pounds. Made to run 24 hours per day the PSU is fully screened and will deliver a massive +5v DC at 17 amps, +15v DC at 1 amp and −15v DC at 5 amps. The complete unit is fully enclosed with removable top lid, filtering, trip switch, 'Power' and 'Run' LEDs mounted on Ali front panel, rear cable entries, etc etc. Units are in good but used condition – supplied for 240v operation complete with full circuit and tech. man **Give your system that professional finish** for only £49.95 + Carr Dim 19" wide 16" deep 10.5" high Useable area 16"w 10.5"h 11.5"d.
Also available **LESS PSU**, with FANS etc. Internal dim. 19"w. 16"d. 10.5"h. ***£19.95***. Carriage & insurance £9.50.

COOLING FANS

Keep your hot parts COOL and RELIABLE with our range of **BRAND NEW** professional cooling fans.
ETRI 99XUOI Dim. 92 x 92 x 25 mm. Miniature 240 v equipment fan complete with finger guard. **£9.95.**
GOULD JB-3AR Dim. 3" x 3" x 2.5" compact very quiet running 240 v operation. **NEW £6.95**
BUHLER 69.11.22. 8-16 v DC micro miniature reversible fan. Uses a brushless servo motor for extremely high air flow, almost silent running and guaranteed 10,000 hr life. Measures only 62 x 62 x 22 mm. Current cost £32.00. **OUR PRICE ONLY £12.95 complete with data.**
MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested EX EQUIPMENT 240 v at £6.25 or 110 v at £4.95 or BRAND NEW 240 v at £10.50. 1000's of other fans Ex Stock. Call for Details. Post & Packing on all fans £1.60

SAVE £250

SUPER PRINTER SCOOP

BRAND NEW CENTRONICS 739-2

ONLY £199

The "Do Everything Printer" at a price that will **NEVER** be repeated. Standard **CENTRONICS** parallel interface for direct connection to **BBC, ORIC, DRAGON** etc. Superb print quality with full pin addressable graphics and 4 type fonts plus **HIGH DEFINITION** internal **PROPORTIONAL SPACED MODE** for **WORD PROCESSOR** applications. 80-132 columns, single sheet, sprocket or roll paper handling plus much more. Available **ONLY** from **DISPLAY ELECTRONICS** at the ridiculous price of ***ONLY £199.00*** + VAT Complete with full manual etc. Limited quantity –Hurry while stocks last.
Options. Interface cable (specify) for BBC, ORIC, DRAGON or CENTRONICS 36 way plg £12.50. Spare ribbon £3.50 each BBC graphics screen dump utility program £8.50.
Carriage and Ins. £10.00 + VAT

BUDGET RANGE VIDEO MONITORS

At a price YOU can afford, our range of **EX EQUIPMENT** video monitors defy competition!! All are for 240v working with standard composite video input. Units are pre tested and set for up to 80 col use on BBC micro. Even where MINOR screen burns MAY exist – normal data displays are unaffected.

1000's SOLD TO DATE

9" HITACHI very compact fully cased. dim. 21cm H x 21cm W x 22cm D. Black and white screen ***£44.95***
12" KGM 320-321, high bandwidth input, will display up to 132 columns x 25 lines. Housed in attractive fully enclosed brushed alloy case. **B/W only *£32.95*** **GREEN screen *£39.95***
24" KGM large screen black & white monitor fully enclosed in light alloy case. Ideal schools, shops, clubs etc. ***ONLY £55.00***
14" BRAND NEW Novex **COLOUR** type **NC1414-CL.** Many exacting features such as RGB TTL and composite video input, **GREEN TEXT** key, internal speaker and audio amp. Even finished in BBC micro matching colours. Fully guaranteed. ***ONLY £199.00***
Carriage and ins on ALL videos £10.00

DUAL 5" DISK DRIVES

Current, quality, professional product of a major computer company, comprising 2 x 40 track **MPI** or **Shugart FULLY BBC COMPATIBLE** single sided drives in a compact, attractively styled, grey ABS structured case with internal switched mode PSU. The PSU was intended to drive both drives and an intelligent Z80 controller with over 70 ic's. The controller has been removed leaving ample space and current on the +, −5, +12 and −12 supply for all your future expansion requirements. Supplied tested with 90 day guarantee in **BRAND NEW** condition with cable for **BBC micro**. Ex Stock at only ***£259.00*** + £10.00 carr. **Limited Quantity Only**

SPECIAL 300 BAUD MODEM OFFER

Another **GIGANTIC** purchase of these **EX BRITISH TELECOM, BRAND NEW** or little used 2B data modems allows US to make the **FINAL REDUCTION**, and for **YOU** to join the exciting world of data communications at an **UNHEARD OF PRICE OF ONLY £29.95**. Made to the highest **POST OFFICE APPROVED** spec at a cost of hundreds of pounds each, the 2B has all the standard requirements for data base, business or hobby communications. All this and more!!

- 300 baud full duplex
- Full remote control
- CCITT tone standards
- Supplied with full data
- Modular construction
- Direct isolated connection
- CALL, ANSWER and AUTO modes
- Standard RS232 serial interface
- Built in test switching
- 240v Mains operation
- 1 year full guarantee
- Just 2 wires to comms. line

NOW ONLY £29.95

Order now – while stocks last. Carriage and Ins. £10.00

GE TERMIPRINTER

A massive purchase of these desk top printer -terminals enables us to offer you these quality 30 cps printers at a **SUPER LOW PRICE** against their original cost of over £1000. Unit comprises of full QWERTY, electronic keyboard and printer mech with print face similar to correspondence quality typewriter. Variable forms tractor unit enables full width – up to 13.5" 120 column paper, upper – lower case, standard RS232 serial interface, internal vertical and horizontal tab settings, standard ribbon adjustable baud rates, quiet operation plus many other features. Supplied complete with manual Guaranteed working ***£130.00*** or ed ***£85.00***, optional floor stand £12.50 Carr & Ins £10.00.

8" 19MB WINCHESTER DISK DRIVE

Made in the UK by a subsidiary of the World's largest disk drive manufacturer. This **BRAND NEW** "end of line" unit offers an outstanding opportunity to add a **MASSIVE 19 mb** of storage to your computer system. Superbly constructed on a heavy die cast chassis the **DRE 3100** utilises 3 x 8" plattens in a dust free cavity. All drive functions are controlled by microprocessor electronics using an **INTEL 8035** cpu and TTL support logic. Data to the outside world is via two comprehensive 8 bit TTL level bi directional data busses with full status reporting for ease of interfacing. Many features such as Av. seek time 35 ms, 512 bytes per sector, +24, −24 and +5 v DC supply, plug in card system, and compact size of approx. 19cm H x 21cm W and 42cm D etc, etc, make this item a real snip.

Units are **BRAND NEW** and **BOXED** and sold at a **FRACTION** of original cost – hence unguaranteed. Complete with 150 page manual, circuits and applications guide.

ONLY £225.00 Carriage £10.00
Suitable power supply unit – sold **ONLY** with drive £39.95.

SEMICONDUCTOR 'GRAB BAGS'

Mixed Semis amazing value contents include transistors, digital, linear, I.C.'s triacs, diodes, bridge recs., etc etc. All devices guaranteed brand new full spec. with manufacturer's markings, fully guaranteed, 50+ ***£2.95*** 100+ ***£5.15***.
TTL 74 Series A gigantic purchase of an "across the board" range of 74 TTL series I.C.'s enables us to offer 100+ mixed "mostly TTL" grab bags at a price which two or three chips in the bag would nnormally cost to buy Fully guaranteed all I.C.'s full spec 100+ ***£6.90*** 200+ ***£12.30*** 300+ ***£19.50***

DATA MODEMS

Join the communications revolution with our range of EX TELECOM data modems. Made to most stringent spec and designed to operate for 24 hrs per day Units are made to the CCITT tone spec With RS232 i/o levels via a 25 way 'D' skt Units are sold in a tested and working condition with data. Permission may be required for connection to PO lines.
MODEM 20-1 Compact unit for use with **MICRONET, PRESTEL** or **TELECOM GOLD** etc 2 wire direct connect 75 baud transmit 1200 baud receive Data i/o via RS232 'D' socket Guaranteed working with data ***£49.95***
MODEM 20-2 same as 20-1 but 75 baud receive 1200 baud transmit ***£130.00***
TRANSDATA 307A 300 baud acoustic coupler RS232 i/o **£95.00** brand new. C£4.50
NEW DSL2123 Multi Standard modem selectable V21 300-300 bps, V23 75-1200, V23 1200-75 full duplex. Or 1200-1200 half duplex modes. Full auto answer via modem or CPU. LED status indicators. CALL or ANS modes Switchable CCITT or BELL 103 & 202. Housed in ABS case size only 2.5" x 8.5" x 9". *£286.00* + VAT
For further data or details on other EX STOCK modems contact sales office.
Carriage on all modems £10.00 + VAT.

PROFESSIONAL KEYBOARD OFFER

An advantageous purchase of brand new surplus allows a great **QWERTY**, full travel, chassis keyboard offer at fractions of their original costs.
ALPHAMERIC 7204/60 full **ASCII** 60 key, upper, lower + control key, parallel TTL output plus strobe. Dim 12" x 6" +5 & −12 DC. ***£39.50.***
DEC LA34 Uncoded keyboard with 67 quality, **GOLD**, normally open switches on standard X, Y matrix. Complete with 3 LED indicators & i/o cable – ideal micro conversions etc pcb DIM 15" x 4.5" ***£24.95*** Carriage on keyboards £3 00

EX STOCK DEC CORNER

BA11-MB 3 5" Box, PSU, LTC	£385.00
DH11-AD 16 x RS232 DMA interface	£2100.00
DLV11-J 4 x EIA interface	£310.00
DUP11 Sych. Serial data i/o	£650.00
DZ11-B 8 line RS232 mux board	£650.00
LA36 Decwriter EIA or 20 ma loop	£270.00
LAXX-NW LA180 RS232 serial interface and buffer option	£130.00
LAX34-AL LA34 tractor feed	£85.00
MS11-JP Unibus 32 kb Ram	£80.00
MS11-LB Unibus 128 kb Ram	£450.00
MS11-LD Unibus 256 kb Ram	£850.00
MSC4804 Qbus (Equiv MSV11-L) 256 kb	£499.00
PDP11/05 Cpu, Ram, i/o, etc.	£450.00
PDP11/40 Cpu, 124k MMU	£1850.00
RT11 ver. 3B documentation kit	£70.00
RK05-J 2.5 Mb disk drives	£650.00
KL8JA PDP 8 async i/o	£175.00
MI8E PDP 8 Bootstrap option	£75.00
VT50 VDU and Keyboard – current loop	£175.00

1000's of **EX STOCK** spares for **DEC PDP8, PDP8A, PDP11** systems & peripherals. Call for details. All types of Computer equipment and spares wanted for **PROMPT CASH PAYMENT.**

66% DISCOUNT

ELECTRONIC
COMPONENTS
EQUIPMENT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C's, Transistors, Relays, Cap s, P.C.B s, Sub-assemblies, Switches, etc. etc surplus to our requirements Because we don t have sufficient stocks of any one item to include in our ads. we are packing all these items into the *BARGAIN PARCEL OF A LIFETIME*". Thousands of components at giveaway prices! Guaranteed to be worth at least *3 times* what you pay. Unbeatable value!! Sold by weight.

2.5kls ***£4.25*** + pp £1.25
5kls ***£5.90*** + £1.80
10kls ***£10.25*** + pp £2.25
20 kls ***£17.50*** + £4.75

ALL PRICES PLUS VAT

All prices quoted are for U.K. Mainland, paid cash with order in Pounds Stirling PLUS VAT. Minimum order value ***£2.00***, Minimum Credit Card order ***£10.00***. Minimum BONA FIDE account orders from Government depts., Schools, Universities and established companies ***£20.00*** Where post and packing not indicated please ADD £1.00. + **VAT** Warehouse open Mon-Fri 9.30 – 5.30. Sat. 10.15 – 5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export enquiries welcome.

DISPLAY -ELECTRONICS-

32 Biggin Way, Upper Norwood, London SE19 3XF
Telephone 01-679 4414 Telex 27924

Appointments

Appointments Vacant display advertisements: rates available on request from Elektor Publishers Ltd., 10 Longport, Canterbury, Kent CT1 1PE. Phone Canterbury (0227) 454439.

RECRUITMENT

We have been successful in filling both senior and junior vacancies from our comprehensive file of applicants who have registered with this Company. We now wish to extend our file to meet future demands and are seeking application for registration mainly from those whose qualifications and experience fall in the following categories:

Management staff with engineering qualifications and experience in Television and Radio broadcasting or related technologies.

Transmitter installation or operations and maintenance engineers and technicians for Broadcasting and Telecommunications services.

Television Studio and Outside Broadcast engineers and technicians.

Graduates with Electronics degree but without material practical experience.

Vacancies occur both for U.K. based and overseas posts.

If you believe your skills or qualifications meet the above broad requirements please contact:

PERSONNEL & ELECTRONICS LTD.

Triumph House 1096 Uxbridge Road Hayes Middlesex UB4 8QH England U.K.
Telephone: 01-573 8333 Telex: 934271

COMPONENTS INDUSTRY
Your Next Career Move

Many of our component manufacturing clients have urgent needs for well qualified technical people – below is a small sample – to discuss these or our other positions telephone **Jackie Squires or Paul Hecquet on Lewes (0273) 471271.**

CHIEF ENGINEER – ESSEX

Salary £16–17,000. Managerial qualities, 5 years Design experience, C.A.D. Electro-Mechanical background. **Ref 5/142**

CHIEF ENGINEER – ESSEX

Salary £16–17,000. Background of at least 3 years Power Supply Design experience with Degree/HNC or equivalent in related area. **Ref 5/142**

PRODUCT MARKETING ENGINEER – SUFFOLK

Salary £10,500. Degree or equivalent with Circuit Design/development experience with a good engineering background. **Ref 5/88**

QUALITY ASSURANCE ENGINEER – SUFFOLK

Salary £9,500. Minimum HNC or related with at least 2 years Design/Test Equipment experience looking for good career in Quality Assurance. **Ref 5/88**

MATERIAL CONTROL MANAGER – KENT

Salary £13–15,000. Semi-conductor background with electronics experience, knowledge of buying/store keeping methods. **Ref 2/365**

PRODUCT ENGINEER – KENT

Salary – depending on experience. Possess Degree in Electronics/Physics/ Electronics at least 2 years experience in Semi-conductor industry. **Ref 2/365**

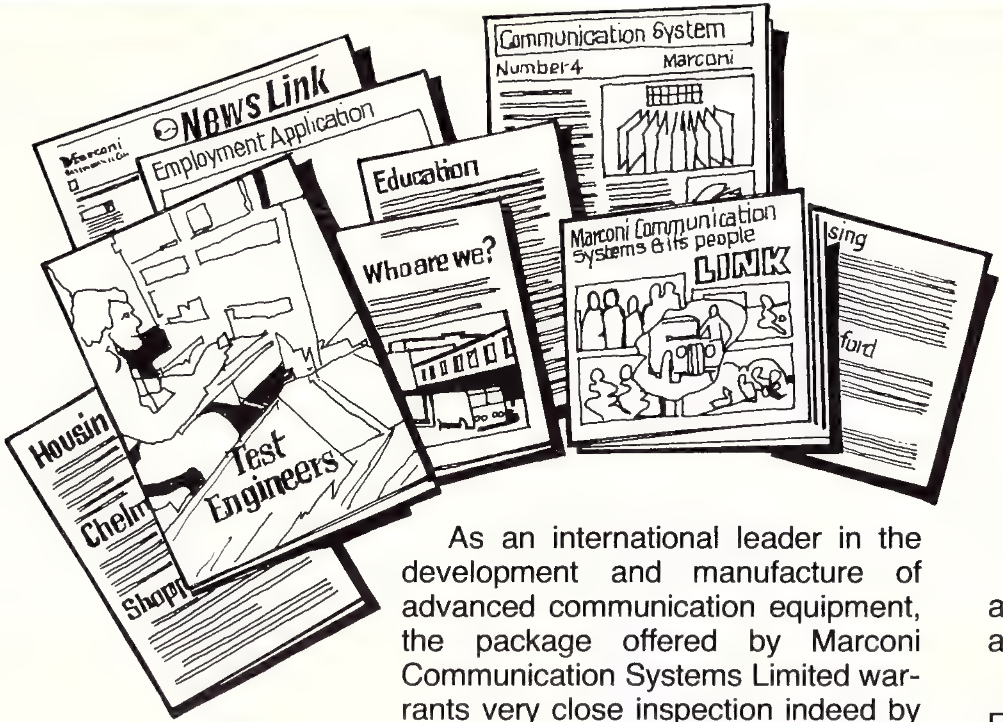
TECHNICAL SUPPORT ENGINEER – HERTS

Salary £10,000 with relocation package. ONC/OND/HNC/HND or related, age early to mid 20's. Instrumentation/Communications experience with strong analogue background to write demo software. **Ref 6/65**

The Electronics Recruitment Company

Temple House, 25/26 High Street, Lewes, East Sussex BN7 2LU Tel: Brighton (0273) 471271

Test Engineers/ Technicians here's a package worth looking into



As an international leader in the development and manufacture of advanced communication equipment, the package offered by Marconi Communication Systems Limited warrants very close inspection indeed by Test Engineers and Technicians.

When you're thinking about a move, you've got to be sure that both your career and lifestyle are going to benefit. And we believe we have a lot to offer on both accounts.

Right now we are seeking men or women to join our Mobile Radio Test and HF Test Departments to work on a wide range of equipment including base stations, mobiles, radio telephones and associated control equipment and also on long haul HF systems.

Our products are among the most advanced of their kind, designed to meet the needs of military and civil communications for a generation to come. Currently we are supplying such customers as public utilities and other major communication users.

In Chelmsford we're very conveniently located for London, the Essex countryside and coast. A modern town with good facilities and a variety of reasonably priced housing.

Applicants should preferably be qualified to HNC in Electronics although practical experience in a test or field services environment is equally important.

Vacancies cover a wide range of seniority and responsibility with salaries between £5,000 – £8,000 p.a. Our information package will tell you more so telephone now for your copy or write with full c.v. to Ken Dumbrell at Marconi Communication Systems Limited, New Street, Chelmsford, Essex, CM1 1PL. Telephone: Chelmsford (0245) 353221, extension 3591 or 3598.

Marconi
Communication Systems

Marconi

Appointments

Appointments Vacant display advertisements: rates available on request from Elektor Publishers Ltd., 10 Longport, Canterbury, Kent CT1 1PE. Phone Canterbury (0227) 54439.

ELECTRONIC ENGINEERING VACANCIES

We have the following permanent vacancies for:

TEST ENGINEERS, HERTS. — good salaries.
INSTALLATION ENGINEERS, Essex and overseas
DEVELOPMENT ENGINEERS (broadcast, studio and antennas, Essex — excellent salaries
ATE DESIGNER — communications — Essex — good salary
SENIOR PRODUCTION ENGINEER COTV, Cambs. — good salary offered.

We also have a good number of contract positions available. Please telephone for details:

May Maguire,
STAFFHIRE
STAFFHIRE LIMITED, 80 High Street, WARE, Herts, SG12 9 AV.
Telephone 0920-5921.

Young Graduate ELECTRONICS ENGINEERS £ 8,000-£ 12,000 Various Locations

Our Clients are seeking Electronics Engineers qualified to degree level or equivalent with at least one or two years experience in one or more of the following:

- Digital or Analogue circuit design
- Microprocessor/PLC Applications
- ATE design
- Servo and microprocessor controls design
- Variable speed drive systems
- Systems Engineering and Software design (Fortran, Assembler, Basic, Coral)
- Micro circuit, thick and thin film design
- VLSI design
- Development Engineers-various backgrounds

These vacancies are at various levels of seniority and are based at several locations throughout England and Wales. Relocation assistance will be offered where appropriate.
Please send a current cv including present salary and salary required or ask for an application form. You will then be considered for all relevant job opportunities.

Jonathan Lee

Technical Recruitment
62 Hagley Road, Stourbridge,
West Midlands DY8 1QD.

☎ **(0384)**
397555 (24 hrs)

Appointments

Freelance Engineers

If you would like to enjoy the very high earning levels and variety of work associated with freelance employment, then talk to us about our highly competitive rates for long and short term contracts with our many clients in the South of England. We are keen to hear from both established Contract Engineers and those contemplating entering this highly lucrative field for the first time where your earnings could exceed

£30,000pa.

Some of the interesting and highly rewarding assignments that we have currently on offer include:

- **UHF and VHF Design**
  for radio communications applications.
- **Test Engineering**
  Development of I.E.E.E. Bus test systems for digital and R.F. measurement.
- **Coral 66 Software Design**
  for message switching applications.
- **Trials Engineering**
  Mathematicians; Analysts; Performance Evaluators; Weapons Systems Engineers; all for defence applications.
- **Power Supply Design**
  Specialising in Switch-mode or High Power systems.
- **Digital/Analogue Design**
  of micro processor based hardware.

TO FIND OUT MORE and to obtain an early interview, please telephone JOHN PRODGER in complete confidence on HEMEL HEMPSTEAD (0442) 47311 during office hours or one of our duty consultants on HEMEL HEMPSTEAD (0442) 212650 evenings or weekends (not an answering machine). Alternatively write to him at the address below.

We also have many clients offering excellent career opportunities at all levels of engineering, sales and management.

Executive Recruitment Services

THE INTERNATIONAL SPECIALISTS IN RECRUITMENT FOR THE ELECTRONICS, COMPUTING AND DEFENCE INDUSTRIES

25-33 Bridge Street, Hemel Hempstead, Herts., HP1 1EG.

ASSISTANT PRODUCTION MANAGER £15,000

A major defence industry manufacturer requires an experienced individual to take control of an extensive production facility involving both electronic/mechanical assembly and test procedures. A background in this field plus good man-management skills are essential.

TEST EQUIPMENT ENGINEERS to £13,000

A well known communications company is seeking both young and experienced electronics engineers to design sophisticated test equipment for advanced electronic products. This will also involve divising new test methods incorporating the latest technology. You will also liaise extensively with other departments to develop working specifications and new test procedures.

BUYER to £11,000

Expanding electronics distributors require a buyer with sound experience in components and systems related to a high turn over retail environment. The position reports to the sales administration manager and requires strong negotiating skills, a commitment to the importance of quality standards, cost reduction and meeting tight delivery schedules.

APPLICATIONS ENGINEER £9,000 + car

Working for a growing electronic component and systems distributor, you will report to the Applications Manager and you will be required to acquire in-depth knowledge of key products including circuit design, bread-boarding and writing software to demonstrate the product. Most of the customer interfacing is likely to be by telephone although occasional country-wide travelling is involved. This is an ideal opportunity for a young engineering graduate to enter the sales and marketing field.

Write or telephone for personal history form to Alan Gall.

Management Personnel
Recruitment Selection & Search
105 St. Peter's Street, St. Albans, Herts.
Telephone: (0727) 35116 (out of hours (07073) 28623)

service

Elektor printed-circuit boards, front panels, and software are obtainable from our Canterbury office. Software may also be ordered from Technomatic Limited.

When ordering, please use the order card provided at the end of this issue and state the issue number, or month of publication, of the magazine, the title of the article, and the number of the board, front panel, or software item. Please allow 6/8 weeks for delivery.

Prices in sterling include 15 per cent value added tax, and should be increased by 55p (UK only) or £ 1.10 (other countries, except the USA) for postage and packing.

Prices in dollars are exclusive of any taxes, and include postage & packing for surface mail. If airmail is required, please add $ 1.50.

SUBSCRIPTION SERVICE

January to December incl. (See also Subscription Order Card towards the end of this issue).

United Kingdom	£11.50
USA/Canada surface mail	$31.00
airmail	$57.00
Other countries surface mail	£13.50
airmail	£27.00

TECHNICAL QUERIES SERVICE

This service is intended to assist readers who experience difficulties in the construction of Elektor projects. Your queries may be submitted by telephone (0227 453474) on Mondays between 13.30 and 16.15, or in writing. The telephone service does not operate during July and August. To help us in being able to send you a quick reply to your letter, we would ask you to observe the following points.

- Your letter should include a stamped self-addressed envelope or, if you live outside the United Kingdom, an International Reply Coupon.
- State at the top left-hand corner of the envelope the code 'TQ' and the subject of your letter.
- We regret that we can only respond to queries relating to Elektor projects published within the last three years. This applies also to queries by telephone.
- It would be appreciated if you could state your query as briefly as possible, and give information on measured voltages, currents, components used, and use capital letters where necessary (as in technical expressions, for instance).
- If certain components are not immediately available in your area, glance through the advertisements in this issue before phoning or writing to us. You'll be surprised how often you can find that elusive part.
- We regret that we cannot enter into correspondence regarding queries which are not directly related to published projects (such as adaptation of the designs to non-Elektor ones). This applies also to additional data on components and theoretical information on Elektor circuits. These exclusions have proved necessary to prevent a disproportionate amount of time being spent by our editorial staff in answering such queries.

SOFTWARE SERVICE

µP TV games on cassette	**No.**	**£**	**$**
15 programs: jackpot, reversie, amazone, code breaker, etc.	007	5.50	11.00
15 programs: invaders, fishing, maze adventure, memory, pontoon, nim, etc.	009	6.90	13.75
15 programs: aliens, flipper, helicopter, pilot, basketball, hangman etc.	010	6.90	13.75
15 programs: snakes & ladders, snap, mazes, break-out, horse races, cosmic adventure, Omega landing etc.	011	6.90	13.75
Software on EPROMS			
dark room computer ext. 1 x 2716 EPROM	514-N	8.40	16.75
DOS software 1 x 2708 EPROM	515	5.30	10.50
talking dice 1 x 2716 EPROM	516	8.40	16.75
ELEKTERMINAL + elekterminal 1 x 2716 EPROM	517	8.40	16.75
morse program for the Junior Computer 1 x 2716 EPROM	518	8.40	16.75
telex program for the Junior Computer 1 x 2716 EPROM	519	8.40	16.75
ASCII keysoft 1 x 2716 EPROM	520	8.40	16.75
character generator and video routines for DOS Junior 1 x 2732 + 1 x 2716 EPROMS	521	18.90	37.75
character generator and video routines for extended Junior 1 x 2732 + 2 x 2716 EPROMS	522	27.30	54.50
character generator 1 x 2732 EPROM	523	10.50	21.00
quantisizer 1 x 2716 EPROM	524	8.40	16.75
universal terminal 1 x 2732 EPROM	525	10.50	21.00
wind direction indicator 1 x 2716 EPROM	526	8.40	16.75
elabyrinth 1 x 2716 EPROM	527	8.40	16.75
EPROM copier 1 x 2716 EPROM	528	8.40	16.75
analytical video display 1 x 82S23 EPROM	529	10.50	21.00
typewriter interface 2 × 2716 EPROM	530	16.80	33.50
µP-controlled frequency meter 1 × 2732 EPROM	531	10.50	21.00

FRONT PANEL SERVICE

		£	$
Elektor Artist (E85)	82014-F	2.80	5.70
precision power supply (E92)	82178-F	2.50	5.00
Prelude (E94...E96)	83022-F	4.40	8.75
7-day timer/controller front panel including membrane switches	83041-F	13.10	26.25
Maestro	83051-F	4.90	9.75
capacitance meter	84012-F	5.20	10.50
real-time analyser	84024-F	7.80	15.50
direct-coupled modem	84031-F	4.50	9.00
pulse generator	84037-F	4.60	9.25
function generator	84111-F	5.00	10.00
µP-controlled frequency meter	84097-F	10.50	21.00

BACK NUMBER SERVICE

Only the back numbers listed below are currently available.
Price are as follows:

any one issue (except July/August) .... £ 1.50
additional issues, each .... £ 1.30
July/August (Summer Circuits) .... £ 3.00

Prices include postage and packing. For overseas orders requiring airmail postage add £ 1.50 per issue (£ 2.00 for July/August).

1978: E34, February; E38, June.
1979: E54, October; E55, November.
1980: E58, February; E65, September; E66, October; E67, November; E68, December.
1981: E70, February; E72, April; E73, May; E77, September.
1982: E89, September; E90, October; E91, November.
1983: E93, January; E94, February; E96, April; E97, May; E99/100, July/August; E101, September; E102, October; E103, November; E104, December.
1984: E105, January; E106, February; E107, March; E108, April; E109, May; E110, June; E111/112 July/August; E113, September; E114, October.

COPY SERVICE

Photocopies of articles can only be supplied from out-of-print back issues of Elektor. State details of the article required, and the number, or month of publication, of the back issue containing the article together with your name and address on the relevant order card at the back of this issue. Cost of any one article is £ 1.50 (incl. p&p). Cost of additional articles (ordered at the same time) is £ 1.30 (incl. p&p).

PRINTED CIRCUIT SERVICE

The following list shows the printed circuits pertaining to projects published within the last six months and which are currently available.

	No.	£	$
E111/112: JULY/AUGUST 1984			
microcomputer power supply protection	84408	2.45	5.00
economical motor drive	84427	2.55	5.00
fridge alarm	84437	2.55	5.00
VHF/AM air-band converter	84438	3.75	7.50
RS 232 analyser	84452	3.45	7.00
musical doorbell	84457	3.05	6.00
frequency meter	84462	5.50	11.00
µP power supply	84477	5.95	12.00
E113: SEPTEMBER 1984			
electronic cross-over filter	84071	5.95	12.00
SCART adapter	84072	3.55	7.00
lamp saver	84073	2.55	5.00
	84083	2.40	4.75
digital tachometer	84079-1	3.40	7.00
	84079-2	4.60	9.25
flash counter	84081	4.35	8.75
direct-coupled modem design	84031	17.85	35.75
ZX81 pulse cleaner	84075	4.50	9.00
RS232 centronix adapter	84078	6.60	12.25
videi inverter	84084	4.05	8.00
E114: OCTOBER 1984			
direct-coupled modem design	84031	17.85	35.75
ZX81 pulse cleaner	84075	4.50	9.00
RS232 centronix adapter	84078	6.60	12.25
video inverter	84084	4.05	8.0
dynamic pre-amplifier	84089	2.85	5.75
E115: NOVEMBER 1984			
burglar alarm	84088	2.70	5.50
valve amplifier	84095	6.30	12.50
autodim	84096	2.65	5.25
telephase	84100	2.50	5.00
TV as monitor	84101	2.70	5.50
mini printer	84106	7.45	15.00
E116: DECEMBER 1984			
time switch	84107	2.75	5.50
function generator	84111	8.15	16.25
give your soldering tip a longer life	84112	2.60	5.25
computer-controlled slide fader	84115-1	11.30	22.50
	84115-2	6.95	14.00
slot-car controller	84130	3.90	7.75
E117: JANUARY 1985			
rumble detector	84109	3.15	6.25
portable guitar amplifier	84128	5.60	11.25
30 watt output stage	85001	3.50	7.00
VHF/UHF modulator	85002	2.50	5.00
Commodore cassette interface	85010	2.90	5.75
µP-controlled frequency meter main board	85013	11.55	23.00
display board	85014	4.70	9.50
crystal oscillator	85015	2.40	4.75

BOOK SERVICE

A number of Elektor books is currently available which may be ordered from certain electronics retailers or bookshops or directly from our Canterbury office.

Book 75	£5.30
Digibook (with PCB)	£6.30
300 Circuits	£5.80
Formant (1) (incl. cassette)	£6.30
SC/MPuter (1)	£5.80
SC/MPuter (2)	£5.80
Junior Computer (1)	£6.90
Junior Computer (2)	£6.90
Junior Computer (3)	£6.90
Junior Computer (4)	£6.90
TV Games Computer	£7.10
Resi & Transi (1)	£6.10
Resi & Transi (2)	£4.80
33 Electronic Games	£4.80
301 Circuits	£5.80
Data Sheet Book	£8.40
Paperware 1	£2.10
Paperware 2	£2.10
Paperware 3	£2.70
Paperware 4	£2.80
Microprocessor Hardware	£7.90
VIA 6522	£3.50
Extended Preset Unit for the Polyphonic Synthesizer (photo copy)	£1.60
Infocards (in cassette)	£3.50
Elektor binder	£3.10

PRINTED CIRCUIT SERVICE

The following list is complementary to the one on the opposite page and shows the printed circuits and software relating to projects which were published more than six month ago. Those marked with an asterisk are in limited supply only and their availability at the time your order is received cannot be guaranteed.

		£	$
E33: JANUARY 1978			
function generator	9453*	4.30	8.50
E42: OCTOBER 1978			
VHF/UHF modulator	9967	2.10	4.25
E44: DECEMBER 1978			
elekterminal	9966	9.90	19.75
E53: SEPTEMBER 1979			
parametric equalizer			
tone control section	9897-2*	2.20	4.50
E55: NOVEMBER 1979			
busboard	80024	7.70	15.50
E61: MAY 1980			
Junior computer			
main board	80089-1	16.60	33.25
display board	80089-2	1.80	3.50
supply board	80089-3	4.00	8.00
E70: FEBRUARY 1981			
voiced/unvoiced detector			
detector board	81027-1*	3.60	7.25
switch board	81027-2*	4.30	8.50
E74: JUNE 1981			
Junior Computer			
−12 V supply	81033-2	1.90	3.75
adaptor board	81033-3	1.70	3.50
E77: SEPTEMBER 1981			
disco light controller	81155	4.20	8.50
DFM + DVM	81156*	5.60	11.25
revolution counter	81171*	6.40	12.50
E79: NOVEMBER 1981			
teletext			
decoder board	82001-2	7.10	14.25
power supply	9968-5A	1.90	3.75
high boost	82029*	2.50	5.00
E80: DECEMBER 1981			
70 cm transverter (Oct.)	80133	16.50	33.00
VHF/UHF converter board	9864	2.30	4.50
flashing light	82038	2.10	4.25
E81: JANUARY 1982			
electronic chimes	82046*	2.10	4.25
E82: FEBRUARY 1982			
universal NiCad charger	82070	2.80	5.50
E84: APRIL 1982			
dynamic RAM card	82017	6.50	13.00
100 W amplifier	82089-1	3.40	6.75
100 W power supply	82089-2	3.20	6.50
mini EPROM card	82093	2.20	4.50
E85: MAY 1982			
6502 housekeeper			
main board	81170-1	5.40	10.75
display board	81170-2	4.00	8.00
elektor artist	82014	13.25	26.50
Z80-A CPU card	82105	9.30	18.50
E86: JUNE 1982			
car alarm	82091*	3.00	6.00
fluorescent tube dimmer	82128	2.10	4.25
electronic fluorescent light starter	82138	1.80	3.50
E87/88: SUMMER CIRCUITS 1982			
light-sensitive switch	82528*	2.10	4.25
5 V power supply	82570	2.90	5.75
E89: SEPTEMBER 1982			
darkroom computer part I			
keyboard	82141-1	4.90	9.75
keyboard interface	82141-2*	2.70	5.50
display	82141-3	3.00	6.00
house telephone system:			
power supply	82147-2*	2.00	4.00
three phase tester	82577	3.50	7.00
E90: OCTOBER 1982			
darkroom computer part II			
light meter	82142-1	2.30	4.50
temperature meter	82142-2	2.10	4.25
process timer	82142-3	2.70	5.50
active antenna:			
R.F. board	82144-1	2.10	4.25
power supply	82144-2	2.10	4.25
digital thermometer	82156*	2.90	5.75
wave shifter for SSB:			
low frequency converter	82161-1	2.70	5.50
high frequency converter	82161-2	3.00	6.00
E91: NOVEMBER 1982			
model train lighting	82157	5.40	10.75
E92: DECEMBER 1982			
precision power supply	82178	5.30	10.50
triopodus electrus diclopus	82179	3.90	7.75
crescendo	82180	6.10	12.25
E93: JANUARY 1983			
3 A computer power supply	83002	2.40	4.75
milli-ohmmeter	83006	2.50	5.00
crescendo d.c. protection and countdown	83008	4.00	8.00
E94: FEBRUARY 1983			
fuse protector	83010	2.10	4.25
universal modem	83011*	7.90	15.75
Prelude			
headphone amplifier	83022-7	5.40	10.75
power supply	83022-8	4.90	9.75
connection board	83022-9	7.80	15.50
main beam dimmer	83028	2.00	4.00
E95: MARCH 1983			
64 k memory card	83014	7.80	15.50
Prelude			
bus board	83022-1	15.20	30.50
line amplifier	83022-6	6.30	12.50
audio trafic lights	83022-10	2.80	5.50
digital luxmeter	83037	2.70	5.50
E96: APRIL 1983			
programmable darkroom timer	82048	5.50	11.00
Prelude			
MC prepreamplifier	83022-2	5.30	10.50
MM preamplifier	83022-3	6.50	13.00
Interlude remote control preamp	83022-4*	4.90	9.75
tone control	83022-5	5.10	10.25
7-day timer/controller	83041	5.70	11.50
E97: MAY 1983			
Maestro	83051-1	2.70	5.50
Watt meter	83052	3.80	7.50
morse converter	83054	3.30	6.50
ASCII keyboard	83058	21.60	43.25
E98: JUNE 1983			
RTTY decoder	83044	3.50	7.00
Maestro (part 2)	83051-2	16.60	33.25
energy meter	83067	3.60	7.25
spectrum display			
filter board	83071-1	4.20	8.25
control board	83071-2	4.10	8.25
display board	83071-3	4.00	8.00
E99/100: JULY/AUGUST 1983			
Cresthermometer	83410	3.60	7.25
flashing running light	83503	2.40	4.75
μProcessor aid	83515	2.90	5.75
microphone amplifier	83552	2.70	5.50
simple D/A converter	83558	2.50	5.00
Prelude buffer	83562	2.30	4.50
heat sink temperature indicator	83563	2.10	4.25
E101: SEPTEMBER 1983			
alarm extension			
transmitter board	83069-1	3.50	7.00
receiver board	83069-2	3.40	6.75
VDU card	83082	13.40	26.75
autotest	83083	5.90	11.75
personal FM	83087	3.00	6.00
E102: OCTOBER 1983			
basicode interface for the Junior Computer	83101-2	2.00	4.00
cosmetics for FSK signals	83106	3.60	7.25
voltage regulator	83088	2.30	6.50
simple anemometer			
memory board	83103-1	4.80	9.50
measuring board	83103-2	2.00	4.00
E103: NOVEMBER 1983			
bus board	80024	7.70	15.50
electronic metronome	83107-1	3.60	7.25
	83107-2	2.10	4.25
CPU card	83108-1	9.20	18.50
	83108-2	5.70	11.50
speed controller for model railway	83110	4.30	8.50
pseudo stereo	83114	2.20	4.50
E104: DECEMBER 1983			
64-way bus extender board	83102	10.60	21.25
video distribution amplifier	83113	2.40	4.75
disco phaser	83120-1	5.60	11.25
	83120-2	3.50	7.00
symmetrical power supply	83121*	4.80	9.50
frost warner	83123	2.50	5.00
E105: JANUARY 1984			
audio embellisher	83133-1	3.10	6.25
	83133-2	4.40	8.75
	83133-3	3.70	7.50
digital cassette recorder	83134	5.50	11.00
wind direction indicator	84001	6.70	13.50
how accurate is your watch	84005-1	4.60	9.25
	84005-2	4.40	8.75
E106: FEBRUARY 1984			
video sync box	83124	2.80	5.50
programmable disco light display	84007-1	10.30	20.50
	84007-2	3.90	7.75
rev counter for diesels	84009	2.00	4.00
capacitance meter	84012-1	5.30	10.50
	84012-2	3.10	6.25
video combiner	84018	2.70	5.50
E107: MARCH 1984			
triac control board	84019	6.10	12.25
Elabyrinth	84023-1	5.00	10.00
	84023-2	4.40	8.75
real-time analyser	84024-1	5.05	10.00
	84024-2	4.30	8.50
UHF video modulator	84029	3.40	6.75
E108: APRIL 1984			
intelligent EPROM eraser	84017	5.30	10.50
real-time analyser	84024-3	15.50	31.00
	84024-4	21.60	43.25
variable a.c. power supply	84035	2.90	5.75
pulse generator	84037-1	6.40	12.75
	84037-2	7.70	15.50
E109: MAY 1984			
real-time analyser	84024-5	4.80	9.50
video display	84024-6	8.00	16.00
short wave pocket radio	84040	6.30	12.50
mini crescendo	84041	6.50	13.00
switching power supply	84049	4.00	8.00
E110: JUNE 1984			
portable distress signal	84048	3.30	6.50
ZX extensions	84054	3.85	8.00
daisywheel typewriter printer interface	84055	5.15	10.50
echo sounder	81105-1	5.00	10.00
	84062	5.95	12.00
FM wireless microphone			
transmitter	84063	3.85	7.75
receiver	83087	3.00	6.00

SOFTWARE SERVICE

	No.	£	$
Elbug (original) 1 × 2716	500	8.40	16.75
Elbug II (SC/MP Book) 1 x 2716	501	8.40	16.75
Cassette routine for NIBL computer 1 x 2716	502	8.40	16.75
Junior computer 1 x 2708	503	5.30	10.50
Illuminated disco floor 1 x 2708	504	5.30	10.50
Chess program for Intelekt 2 x 2716	505	16.80	33.50
Junior tape monitor (TM) 1 x 2716	506	8.40	16.75
Junior printer monitor & PME 1 x 2716	507-N	8.40	16.75
Reprogramming 507 to 507-N			
Junior data bus control 1 x 82S23	508	5.30	10.50
Time signal processor 1 x 2716	509	8.40	16.75
150 MHz frequency meter 2 x 82S23	510	10.50	21.00
Junior disassembler, programmable software, system vectors and hexdump 1 x 2716 EPROM	511	8.40	16.75
autonomous switch-clock 1 x 2716 EPROM	512	8.40	16.75
keysoft polyphone keyboard 1 x 2716 EPROM	513	8.40	16.75
dark room computer 1 x 2716 EPROM	514	8.40	16.75

fied ads

NS OF ACCEPTANCE OF IED ADVERTISEMENTS

ents are accepted subject to the conditions ap- ur current rate card and on the express under- t the Advertiser warrants that the advertisement ntravene any Act of Parliament nor is it an infringe- e British Code of Advertising Practice.

ublishers reserve the right to refuse or withdraw any ement.

hough every care is taken, the Publishers shall not be for clerical or printer's errors or their consequences.

The Advertiser's full name and address must accompany ach advertisement submitted.

he prepaid rate for Classified Advertisements is 25 pence per word (minimum 12 words). Semi-display setting £6.50 per single column centimetre (minimum 2.5 cms.). All cheques, postal orders, etc. to be made payable to Elektor Publishers Ltd. Treasury notes should always be sent by registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Elektor Publishers Ltd., 10 Longport, Canterbury, Kent CT1 1PE.

ELEKTOR KITS assembled and tested* by Electronics Apprentices under supervision for as little as £10*, inside a purpose-built electronics workshop (*depending on type of kit and complexity). Contact: A.J. Smith, Dept. K.A., Electronics Workshop, Lincoln I.T.E.C., Lincoln LN2 4JZ. Tel. 0522 43532.

AMTRON electronic kits and instrument cabinets. Over 70 kits in our range plus special offer on obsolete kits. Send S.A.E. for catalogue. Amtron UK Ltd., 7, Hughenden Road, Hastings, East Sussex TN34 3TG.

SECURITY
Alarm Systems

FREE COMPREHENSIVE CATALOGUE!

- ***LOWEST DISCOUNT PRICES***
- ***HIGHEST QUALITY EQUIPMENT***
- ***FREE DIY DESIGN GUIDE***
- ***FULLY ILLUSTRATED***
- ***MICROCHIP CIRCUITRY***
- ***QUICK DESPATCH SERVICE***
- ***FULL INSTRUCTIONS***

SEND SAE OR PHONE

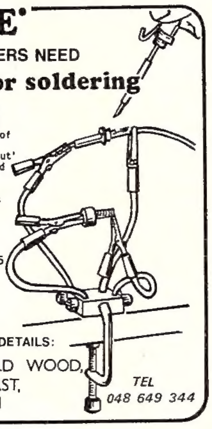
C-TEC SECURITY, Dept. EK,
60 Market St, Wigan WN1 1HX
Telephone (0942) 42444

Trade Enquires Welcome

'GRIPMATE'

ELECTRONIC ENGINEERS NEED

'Extra hands' for soldering and assembling



The basic "GRIPMATE" kit consists of a base block secured with the simple but firm clamp. Two 'stayput' wires, with croc-clip ends are held into the block with thumb screws rapidly and positively adjusted to an infinite number of positions to hold and grip small parts and components

BASIC KIT (BLOCK - CLAMP - - 2 FLEXI-ARMS) £3.85
2 EXTRA FLEXI-ARMS £1.00
MAGNET ARM £1.50
MAGNIFIER ARM £2.50
ALL INCL VAT POST & PKG
SEND NOW CHQ/PO OR SAE DETAILS:

KEMPLANT LTD DURFOLD WOOD,
PLAISTOW, BILLINGSHURST,
WEST SUSSEX, RH14 0PN

TEL
048 649 344

SWC

THE SCIENTIFIC WIRE COMPANY
811 Forest Road, London E17.
Telephone 01-531 1568

SWG	1 lb	8 oz	4 oz	2 oz
ENAMELLED COPPER WIRE				
8 to 34	3.63	2.09	1.10	0.88
35 to 39	3.82	2.31	1.27	0.93
40 to 43	6.00	3.20	2.25	1.61
44 to 47	8.67	5.80	3.49	2.75
48	15.96	9.58	6.38	3.69
SILVER PLATED COPPER WIRE				
14 to 30	9.09	5.20	2.93	1.97
TINNED COPPER WIRE				
14 to 30	3.97	2.41	1.39	0.94
Fluxcore Solder	5.90	3.25	1.82	0.94

Prices include P&P VAT. Orders under £2 add 20p.
SAE for list of copper and resistance wire.
Dealer enquiries welcome.

PARAPHYSICS JOURNAL (Russian translations), Psychotronics, Kirlianography, heliphonic music, telekinetics. Computer Software, S.A.E. 4 x 9" to PARALAB, DOWNTON, WILTS.

OSCILLOSCOPES (tested) £60+, Printers £15+, PDP11 system. DIGISCOPE latching logic monitors £80 (distributors wanted). Sinclare 01-316 1779.

FREE! Parcel of components worth £10. Send only 80p postage! D. Horsley, 113 Clare Road, Braintree, Essex.

advertisers index

Appointments Vacant advertisements 1-76/79

Akhter Computer Group 1-68/69

Chiltern Electronics 1-09
Cirkit Holdings 1-17
Cricklewood Electronics 1-11

Display Electronics 1-75

East Cornwall Components 1-14
Electrovalue 1-08

Greenweld Electronics 1-70

Harrison Electronics 1-82
Hart Electronic Kits 1-15
Hemmings Electronics 1-70
Henry's 1-13

ILP Electronics 1-16

Kemplant 1-82
Keytronics 1-73

Maplin Electronic Supplies 1-84
Marconi Communication systems 1-77
Microrange Electronics 1-82

Newrad Instrument Cases 1-10

Brain J. Reed 1-08
RVM Audiotronic 1-10

Silica Shop 1-83
Skybridge 1-08
Skywave Software 1-13/15
Systems Electronique 1-10

Technomatic 1-02/05
The Scientific Wire Company ... 1-82
TK Electronics 1-12

Watford Electronics 1-06/07

MICRORANGE ELECTRONICS
UNIT 258, STRATFORD WORKSHOPS, BURFORD ROAD (near Stratford Centre)
LONDON E15 2SP
TEL: 01-536 1415

Recently opened component shop in the heart of Stratford. (You will find us on the 2nd floor.)

We specialize in the manufacture of:

Printed Circuit Boards.
No quantity is too small.

We also supply:
Photo Board and associated chemicals at very keen prices. See below:

6×4" Single sided	1.80
8×5" Single sided	2.10
6×4" Double sided	2.00
8×5" Double sided	2.40

Other sizes available

ALL PRICES INCLUDE VAT
Please add 50p for P&P

SOME SPECIAL OFFERS
(Many others in stock)

NE5534	1 off **£1.15** 10 off **£1.05**
NE5532	1 off **£1.45** 10 off **£1.15**
TL071	1 off **45p** 10 off **42p**
TL072	1 off **55p** 10 off **50p**
TL074	1 off **85p** 10 off **78p**
78PO5 5V 10A Reg	**5.50 each**
7812 12V 1A Reg	**30p each**
VN67AF Power Fet	**65p each**
60W Spot Bulbs various colours	**70p each**
100W Spot Bulbs various colours	**1.25 each**
2 metre × 1 metre SPK Cloth	**2.95**
10×12" Fibreglass PC Board	**2.25 each**
150W Power amp module	**12.50**
3 Way 700W Sound to Lite unit	**17.50**
Telephone recording unit	**15.00**

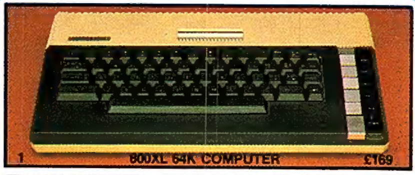
Please come and see our range

ELECTRONIC COMPONENTS

- RESISTORS
- CAPACITORS
- TRANSISTORS
- POTENTIOMETERS
- MULTIMETERS
- PLUGS
- VOLTAGE REGULATORS
- IC SOCKETS
- DIODES
- PRESETS
- LEDS
- SWITCHES
- SOCKETS
- INTEGRATED CIRCUITS

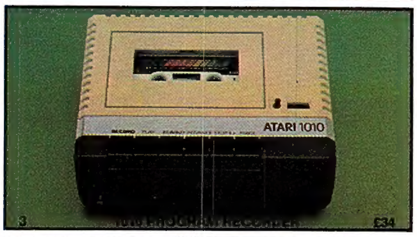
TRADE ONLY
Write or phone for full Trade Catalogue

HARRISON ELECTRONICS
22 MILTON ROAD, WESTCLIFF-ON-SEA
ESSEX SS0 7JX Tel: (0702) 332338

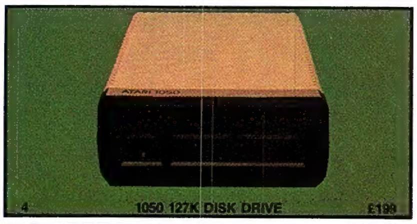


1 800XL 64K COMPUTER £169

2 800 48K COMPUTER £69

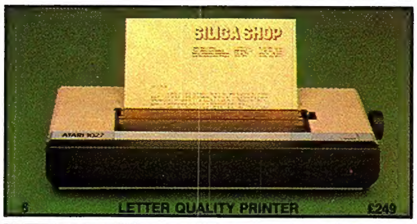


3 1010 PROGRAM RECORDER £34

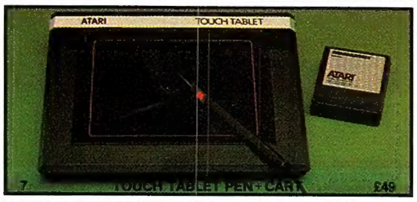


4 1050 127K DISK DRIVE £199

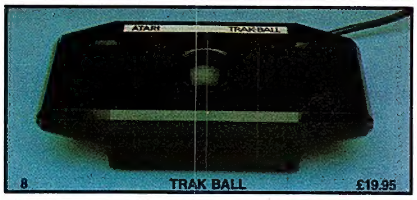
5 1020 4 COLOUR PRINTER £99



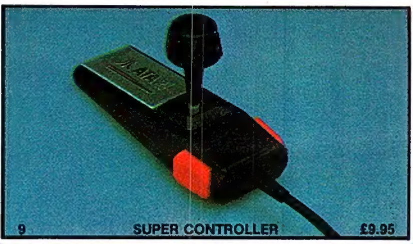
6 LETTER QUALITY PRINTER £249



7 TOUCH TABLET PEN + CART £49



8 TRAK BALL £19.95



9 SUPER CONTROLLER £9.95

ATARI XL

THE NEW ATARI 64K 800XL £169

EVERYTHING YOU WANT FROM A HOME COMPUTER

1. **ATARI 64K 800XL - £169:** The Atari 800XL has many facilities and includes such advanced specifications that you will be amazed by its performance. At the new retail price of only £169 for a full specification 64K computer with a proper full stroke keyboard, we believe that the 800XL cannot be beaten. Just look at the following specifications:-

   COLOUR CAPABILITIES: 16 colours and 16 intensities giving 256 different colours (all of the 256 colours can be displayed at the same time).
   OPERATING SYSTEM: 24K ROM including Atari Basic programming language and a self diagnostic test program.
   KEYBOARD: Full stroke design with 62 keys including help key and 4 special function keys, international character set and 29 graphics keys.
   SOUND: 4 independent sound synthesisers each capable of producing music across a 3½ octave range or a wide variety of special sound effects. (Additional programming can achieve an octave range of up to nine octaves!)
   DISPLAY: 11 graphic modes and 5 text modes. Up to 320×192 resolution. Maximum text display 24 lines by 40 columns.
   SPECIAL ATARI INTEGRATED CIRCUITS: GTIA for graphics display. Pokey for sound and controller ports. Antic for screen control and I/0 (Input/Output).
   CPU: 6502C microprocessor - 0.50 microsecond cycle and a clock speed of 1.79 MHz.
   EXTENDED GRAPHICS FUNCTIONS: High resolution graphics. Multi-coloured character set. Software screen switching. Multiple redifined character sets. Player missile (sprite) graphics. Fine screen scrolling. Changeable colour registers. Smooth character movement. Simple colour animation facilities.
   PROGRAMMING FEATURES: Built in Atari Basic programming language supporting peek, poke and USR plus at least 8 other languages available. The help key will provide additional information and menu screens with certain software. Full on-screen editing is available as well as syntax checking on entry.
   INPUT/OUTPUT: External processor bus for expansion with memory and peripherals. Composite video monitor output. Peripheral port for direct connection to Atari standard peripherals. Software cartridge slot is included as well as 2 joystick controller ports.
   SOFTWARE: Over 1,500 items of software are available including self teaching programs with unique voice over. The range of programs includes Education, Home Management & Programming aids. There is also APX (Atari Program Exchange) and of course Atari's famous entertainment software now at only £9.95. In addition there is a host of support and help available from specialist Atari magazines like Antic and Analog and from over 75 Atari books/manuals.
2. **ATARI 800 48K COMPUTER - £69:** We have a limited number of the Mk1 model 800 computer with 48K. The price is £69 (as a games machine) or £99 with the Basic Programmer Kit (Basic cartridge & 2 manuals). Both come with a full 12 months guarantee.
3. **ATARI 1010 PROGRAM RECORDER - £34:** For low cost storage and retrieval capability. Data transmission 600 baud. Storage capability 100K bytes on a sixty minute cassette. Track configuration four track, two channels (digital and audio). Auto record/playback/pause control/unique soundthrough facility. Also included is built in accidental erasure prevention and automatic shutoff after each program as well as a 3 digit tape counter.
4. **ATARI 1050 DUAL DENSITY DISK DRIVE - £199:** 5¼" disks holding 127K randomly accessible bytes provide both expansion and flexibility for your 400/800 or XL system with new 'helpful' DOS 3. All customers who purchase a Disk Drive from Silica Shop will be automatically given a FREE set of 100 programs on 3 Disks recorded on both sides.
5. **ATARI 1020 COLOUR PRINTER - £99:** Printer and Plotter with four colour graphic print capability. 40 column width printing at 10 characters per second. Can print 5, 10 and 20 characters per inch. 64 character sizes. Prints text in 4 directions. Choice of line types.
6. **ATARI 1027 LETTER QUALITY PRINTER - £249:** For word processing letters in professional type. Print speed of 20 chars per second.
7. **ATARI TOUCH TABLET - £49:** Enables you to draw and paint pictures on your T.V. screen, with the touch of a stylus.
8. **ATARI TRAK BALL CONTROLLER - £19.95:** Enables cursor movement in any direction and adds arcade realism to your games.
9. **ATARI SUPER CONTROLLER -£9.95:** The ultimate joystick with double fire button to give you a greater competitive edge in your games.

SILICA SHOP ARE THE No1 ATARI SPECIALIST

Silica Shop are now firmly established as the No 1 Atari retail/mail order and wholesale specialist in the U.K. We already offer our service to over 120,000 customers, 10,000 of whom have purchased Atari Home Computers. Because we specialise (and with a turnover of £1.5 million), we are able to keep prices low by bulk purchases. Ring one of our 45 staff and we will be glad to be of service to you. Complete the coupon below and we will send you our Atari pack with price list and colour catalogue:

EXTENDED TWO YEAR GUARANTEE: We are an Atari Service Centre, able to service and repair Atari equipment and have added a 12 month guarantee to the year offered by Atari, giving you a full 2 year guarantee on your computer if you buy it from us.

SPECIALIST SUPPORT: Our technical staff are always available on the telephone to help and advise you. We endeavour to hold stocks of every Atari compatible item available in the U.K. and we stock over 75 Atari books and manuals.

AFTER SALES SERVICE: Your name will automatically be added to our mailing list and you will receive price lists, newsletters and details of new releases and developments as well as special offers which are exclusive to Silica Atari Computer Owners.

LOW PRICES: Our prices are extremely competitive and we will normally match any lower price offered by our competitors.

FREE COMPUTER OWNERS CLUB: This is open to all Atari computer owners irrespective of where you purchased your equipment. Membership is FREE and entitles you to receive bulletins giving details of new releases and developments. Send now for your FREE information pack, price list & colour catalogue.

PAYMENT: We accept cash, cheques, postal orders and all Credit Cards. We also offer credit facilities over 1, 2 or 3 years, please write for a written quotation.

NEXT DAY DELIVERY - FREE: All goods despatched from Silica Shop are normally sent by first class post or parcel post FREE OF CHARGE. As a special introductory offer for a limited period only we will be sending all Computers and Disk Drives by a next day delivery service at our expense.

So fill in the coupon below with a literature enquiry or order and begin to experience a specialist Atari service that is second to none.

SILICA SHOP LTD, 1-4 The Mews, Hatherley Road, Sidcup, Kent, DA14 4DX Tel: 01-309 1111

ORDER NOW-OR SEND FOR A FREE COLOUR BROCHURE

**To: SILICA SHOP LTD, Dept EK 0185, 1-4 The Mews, Hatherley Road,
Sidcup, Kent, DA14 4DX Telephone: 01-309 1111**

LITERATURE REQUEST:

☐ Please send me your FREE colour brochures and 16 page price list on Atari Computers.
☐ I own a .... Videogame ☐ I own a .... Computer
Mr/Mrs/Ms: .... Initials: .... Surname ....
Address: ....
....
.... Postcode: ....

ORDER REQUEST:

Please send me:
☐ 800XL 64K Computer £169
☐ 800 48K Computer £99
☐ 1010 Program Recorder £34
☐ 1050 127K Disk Drive £199
☐ 1020 4 Colour Printer £99
☐ Letter Quality Printer £249
☐ Touch Tablet + Cartridge £49
☐ Trak Ball £19.95
☐ Super Controller £9.95

☐ I enclose Cheque/P.O. payable to Silica Shop Limited for the following amount £...................................

☐ CREDIT CARD - Please debit my Access/Barclaycard/Visa/American Express/Diners Club
Card Number ....

MAPLIN
1985 Buyers Guide to Electronic Components
PRICES ON THE PAGE
Price £1·35
NOW WITH PRICES ON THE PAGE
including Heathkit section
PRICE £1·35
BUYER'S GUIDE TO ELECTRONICS AND HOME COMPUTERS
£1·25

HUNDREDS OF NEW LINES

The amazing Maplin Catalogue is here again! The new edition is packed with hundreds and hundreds of new electronic components to bring you right up to date with all the latest developments. As all home constructors agree (and a good many professionals too) the Maplin Catalogue is the one essential piece of equipment they really need. And now with all our **prices on the page** the Maplin Catalogue is better value than ever.

On Sale From 10th November 1984.

Pick up a copy as soon as it's published at any branch of W.H. Smith or in one of our shops. The price is still just £1.35, or £1.75 by post from our Rayleigh address (quote CA02C).

Post this coupon now for your copy of the 1985 catalogue.
Price £1.35 + 40p post and packing. If you live outside the U.K. send £2.40 or 11 International Reply Coupons.
I enclose £1.75.

Name ....

Address ....

....

.... E 1/85

MAPLIN
ELECTRONIC SUPPLIES LTD

Maplin Electronic Supplies Ltd. Mail Order: P.O. Box 3, Rayleigh, Essex SS6 8LR.
Tel: Southend (0702) 552911. •Shops at: 159-161 King Street, Hammersmith, London W6. Tel: 01-748 0926. •8 Oxford Road, Manchester. Tel: 061-236 0281.
•Lynton Square, Perry Barr, Birmingham. Tel: 021-356 7292.
•282-284 London Road, Westcliff-on-Sea, Essex. Tel: 0702-554000.
•46-48 Bevois Valley Road, Southampton. Tel: 0703-25831. All shops closed all day Monday.